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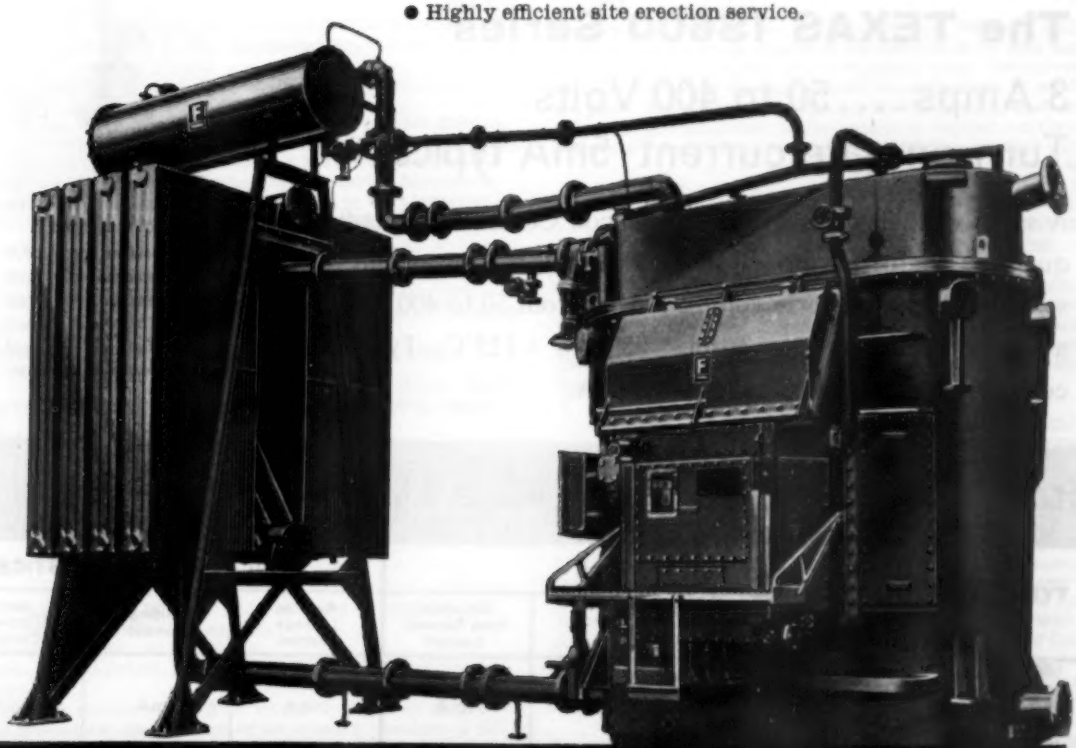

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1S601	100 V						
1S602	200 V						
1S603	300 V						
1S604	400 V						

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ELECTRICAL ENGINEERING ABSTRACTS

Volume 63 **OCTOBER 1960** **Number 754**

GENERAL

(For abstracts on circuit theory see also Lines . Networks . Filters)

614.825

5945 ACCIDENTS DUE TO ELECTRICITY, OCCURRING IN SWITZERLAND IN 1958. E.Homberger.
Bull. Assoc. Suisse Elect., Vol. 51, No. 10, 505-14 (May, 1960). In French.

Official statistics are given in Tables for electrical accidents for the year 1958 and are compared with the previous year and for the past decade. Analyses are given for grades of electrical employees and the public, h.v. and l.v., and by more detailed forms of utilization. The duration of incapacity for various employments is tabulated. Some unusual accidents are quoted and there are general notes on common accidents such as when using portable equipment. E.H.W.Banner

614.825

5946 FIELD TREATMENT IN ELECTRIC SHOCK CASES. II. W.B.Kouwenhoven, G.G.Knickerbocker, W.R.Milnor and J.R.Jude.
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 19-21 (1960) = Pwr Apparatus Syst., No. 47, (April, 1960).

For Pt I, see Abstr. 4350 of 1957. Further details are given on methods of treatment of respiratory failure and ventricular fibrillation. A portable defibrillator is described and the closed-chest heart-massage method of maintaining circulation during fibrillation is discussed. Results are given of various tests on dogs involving fibrillation times up to 15 min. and closed-chest massage resuscitation.

621.3

5947 THE WORK OF THE BRITISH STANDARDS INSTITUTION IN RELATION TO THE RADIO AND ELECTRONICS INDUSTRY. H.A.R.Binney.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 487-93 (July, 1960).

621.3.013 : 621.314.2 : 538.3

ELECTROMAGNETIC FIELD OF A FERROMAGNETIC TRANSFORMER. See Abstr. 5984

POWER SUPPLY
POWER STATIONS

621.311.1 : 681.142

5948 AN APPLICATION OF DIGITAL COMPUTERS TO POWER SYSTEM PLANNING.
J.B.Kirkwood, N.B.Heal and R.C.Moffat.
Instn Engrs, Austral., elect. mech. Engng Trans, Vol. EMI, No. 1, 17-23 (May, 1959).

The planning studies required for an electrical power system frequently necessitate consideration of the detailed operation of the system over future periods of many years. The labour involved in this work, if proper allowance is to be made for economic power-station operation, spinning reserve requirements and for the interaction of station operations, one on another, is very large if manual techniques are employed. The adoption of automatic computing procedures has achieved improved accuracy, closer simulation of actual operating conditions and very greatly increased speed and consistency of results. This permits many more alternatives to be usefully examined. Details are given of a computer technique which has been used by the Electricity Commission of New South Wales employing UTECOM, the Deuce high speed general purpose digital computer installed at the University of N.S.W. Typical results obtained by the application of this computer to system planning studies are included.

621.311.1 : 621.398

REMOTE CONTROL AND SUPERVISION OF SUPPLY INSTALLATIONS IN COUNTRY DISTRICTS. See Abstr. 5902

621.311.1 : 621.396.1

RADIOCOMMUNICATION IN THE POWER INDUSTRY. See Abstr. 5771

621.311.1 : 621.316.722

USE OF THE TRANSFORMER FOR REGULATION PURPOSES. See Abstr. 5438

621.311.153

5949 THE ANALYSIS OF DAILY LOAD CURVES. U.Legnaioli.
Energia elett., Vol. 37, No. 3, 202-15 (March, 1960). In Italian.

The results are presented of the analysis of 24 daily load curves for the distribution authorities in Northern Italy. The curves are samples for a week-day and weekend for each of the 12 months of the year. The method of calculating the optimum pumped-storage capacities and pump size for the system is detailed and the method has general application to any system over any period of time. M.Rathbone

621.311.161 : 621.316.728

5950 AUTOMATIC REGULATION OF THE TRANSMITTED ELECTRICAL POWER IN ENERGY SYSTEMS. J.Měřička.
Elektrotech. Obzor., Vol. 49, No. 4, 205-8 (1960). In Czech.

Describes briefly the principles of power flow on tie-lines between power systems. The regulation of tie-line power-flow both by the blocking method and by tie-line bias control is explained. The operation, advantages and shortcomings of the two systems are discussed. A calculated example follows. N.Klein

621.311.161 : 621.316.728

5951 AN ANALYTICAL REVIEW OF POWER-SYSTEM FREQUENCY, TIME AND TIE-LINE CONTROL. D.Broadbent and K.N.Stanton.
Proc. Instn Elect. Engrs, Monogr. 395 S, publ. Sept., 1960, 8 pp. To be republished in Part C.

Over the past decade and a half there have been proposed three schemes of control for electricity supply systems interconnected through tie lines. In chronological order they are the speed-governed system with frequency biasing, the time-governed system and the load-phase energy control. Computer studies are described which compare the three systems using a performance index of the integral square error. Certain conclusions are drawn by applying this criterion both to the frequency error of the isolated system and to the tie power-flow error of the interconnected system.

621.311.2

5952 SELECTION OF POWER STATION SITES. F.H.Dickinson.
Elect. Rev., Vol. 167, No. 1, 3-8 (July 1, 1960).

The various factors to be considered in selecting a site for a power station are discussed, including initial cost, distance from solid fuel resources, availability of water for cooling, site access, ash disposal, nature of soil, water levels of sea and rivers and distances from load centres.

621.311.21

5953 ALTERNATOR DESIGN AND POWER STATION ARRANGEMENT. E.Wiedemann.

Bull. Assoc. Suisse Elect., Vol. 51, No. 7, 352-9 (April 9, 1960). In German.

A discussion of certain design problems in hydroelectric sets, including the arrangement of two Pelton runners, possible increases in specific alternator output, the valuation of machine losses, and various bearing arrangements for vertical-shaft machines.

P.Linton

621.311.21 : 621.316.7

FREQUENCY MAINTENANCE, POWER REGULATION AND OTHER PROBLEMS IN A MODERN HYDROELECTRIC STATION. See Abstr. 5429

621.311.21 : 621.398

REMOTE CONTROL OF DUFFERIN FALLS GENERATING STATION. See Abstr. 5899

621.311.21 : 621.313.322-8

GENERATORS FOR THE SVÆLGFOS III HYDROELECTRIC POWER STATION IN NORWAY. See Abstr. 5353

621.311.22

5954 THE ELECTRIC POWER STATION AT BAUDOUR. THE FIRST BELGIAN STATION FOR 600°C. C.Wilwertz.

Rev. Soc. Roy. Belge Ingen. Industr., 1960, No. 4, 196-217 (April). In French.

A detailed description of the complete plant, including boilers, turbine and alternator. Emphasis is laid on the suitability of the materials used to meet the requirements of the high temperature. The output of the H_2-cooled alternator is 154 MVA at 15 kV. The principal technical characteristics of the plant are listed. A bibliography is added.

R.G.Jakeman

621.311.23

5955 COMBINED HEATING AND POWER STATIONS BASED ON AIR AND GAS TURBINES. M.Wolf.

Abhandl. Dtsch. Akad. Wiss. Berlin Kl. Math. Phys. Tech., 1959, No. 3, 64 pp. In German.

An extensive review of existing theoretical and practical information on all types of installations. Sections deal with hot air turbines, open-cycle gas turbines, free-piston generator installations and plants using mixed systems. The use of atomic reactors is considered and calculations show the economics of this type of plant.

P.Linton

621.311.25

5956 THE BETA STUDY PROJECT, A DANISH NUCLEAR POWER STATION. S.Grove, H.Harboe, J.E.Kjemtrup, C.E.Lundgren, C.U.Porse, S.I.Rasmussen, P.Sølbæk and J.Harne.

Ingeniøren B, Vol. 69, No. 12, 361-90 (June 15, 1960). In Danish.

A special number devoted to this nuclear-station equipped with a British model gas-cooled reactor. To suit Danish conditions, a single-reactor station was chosen. The choice of the size of the plant is first discussed, contractors are listed and the main technical data given. The electrical output will be 175 MW net, the thermal output 574 MW and the thermal efficiency 30.5%. The reactor will use natural uranium sheathed in Magnox as fuel, graphite as moderator, and CO_2 as coolant. Reactor calculations shown include criticality, thermal effects, control rod operation and reaction dynamics. Under the heading of care are discussed the construction of the graphite and its transport in the reactor system and Wigner effects. The design of the reactor vessel, choice of steel plate, heat exchangers, auxiliary systems, instrumentation including safety and leakage measurements, and house services are dealt with and a detailed analysis is given of capital and running costs.

G.N.J.Beck

621.311.25

5957 NUCLEAR POWER STATIONS. A.L.G.Lindley.

Trans S. African Inst. Elect. Engrs, Vol. 50, Pt 11, 262-76 (Nov., 1959).

A short review of types of reactors built or under construction for power generation. Due to availability of cheap coal, nuclear power is unlikely to be competitive in South Africa for many years.

A.P.Wilmshurst

621.311.25 : 681.142

TRAINING SIMULATOR FOR NUCLEAR POWER PLANT OPERATION. See Abstr. 5922

621.311.42

5958 NEW DISTRIBUTION SUBSTATIONS FOR DIRECT 230 kV TO 12 kV TRANSFORMATION ON THE B.C. ELECTRIC COMPANY SYSTEM. M.B.Callander.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1597-1607 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

A detailed description of the construction of the substations at Mainwaring and Newell. It is concluded that the maximum desirable size of 12 kV outdoor distribution was reached with a structure which provided for a maximum s.c. duty of 1300 MVA and a maximum current rating of 4 kA. A bibliography and a discussion are added.

R.G.Jakeman

621.311.6

5959 VICKERS VANGUARD ELECTRICS. H.Zeffert.

Elect. Engng, Vol. 78, No. 12, 1164-7 (Dec., 1959).

Outlines the 300 kVA rectified a.c. system of fairly conventional layout, but including a number of unusual features particularly in respect of the two-stage emergency supply arrangements, and transistorized static power-packs for direct operation of fluorescent tubes from 28 V d.c. supply.

J.T.Hayden

ELECTRIC MACHINES

621.313.017.31

5960 POLE-FACE LOSSES IN ALTERNATORS. AN INVESTIGATION OF EDDY-CURRENT LOSSES IN LAMINATED POLE SHOES. J.Greig and K.Sathirakul.

Proc. Instn. Elect. Engrs, Monogr. 404 S, publ. Oct., 1960, 9pp. To be republished in Part C.

A recent re-examination of the phenomenon of tooth-ripple flux pulsations at laminated pole-faces in alternators resulted in a new theoretical analysis by means of which the pole-face eddy-current loss can be calculated. The primary purpose of the present investigation has been to make measurements of tooth-ripple losses which could be compared with values calculated from the new formulae. In order to make these measurements an experimental homopolar machine was built and values of eddy-current losses were determined over a fairly wide range of flux density and frequency for four different thicknesses of lamination. It is found that there is moderately good agreement between calculation and experiment for the thicker laminations and in general the agreement is markedly better with the new formulae than with those previously developed.

621.313.066 : 537.3

5961 THERMAL TRANSIENTS IN GRAPHITE–COPPER CONTACTS. J.A.Greenwood and J.B.P.Williamson.

Brit. J. appl. Phys., Vol. 11, No. 8, 389 (Aug. 1960).

This letter draws attention to two errors in a paper by Davies (Abstr. 3285 of 1960).

P.M.Davidson

621.313.066 : 537.3

5962 THERMAL TRANSIENTS IN GRAPHITE–COPPER CONTACTS. W.Davies.

Brit. J. appl. Phys., Vol. 11, No. 8, 389-90 (Aug., 1960).

Aknowledgment of the letter by Greenwood and Williamson (see preceding abstract).

P.M.Davidson

621.313.1

5963 HYDRAULIC MODELS FOR RESEARCH ON THE FLOW OF COOLING GAS IN LARGE ELECTRIC MACHINES. K.Limbora, L.Plechác̆ and K.Eisenwort.

Elektrotech. Obzor, Vol. 49, No. 5, 260-8 (1960). In Czech.

Develops the technique of measuring the flow-velocity field of gases in electrical machines on hydraulic models. Describes and illustrates experimental model equipments and explains the theoretical basis for their use. Gives a sketch of the model of a 16-pole hydroelectric generator and the results of measurements of a velocity-vector field for another machine are given. Methods of measurements are briefly described.

N.Klein

621.313.1 : 681.142

5964 A NEW LOOK AT LARGE MACHINE DESIGN. D.D.Stephen.

A.E.I. Engng Rev., Vol. 1, No. 1, 3-9 (May, 1960).

Describes how digital computers can be applied to much of the routine calculation work in the development of large electrical machines.

621.313.1 : 538.3

5965 ON THE LOSS DUE TO EDDY CURRENTS IN A CYLINDRICAL CORE, IN THE QUASI-STATIONARY STATE. O.Beaufays.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 11, 1078-83 (1959). In French.

A general formula is derived for the energy loss due to eddy currents in a long cylindrical core of arbitrary cross-section, in a sinusoidal magnetic field parallel to the axis of the cylinder.

H.Morrison

621.313.1

5966 RESISTANCE MEASUREMENTS OF DUCT WITH MULTIPLY REPEATED CROSS SECTION CONSTRICTIONS. V.Dvořák, J.Hak and J.Vaníček.
Elektrotech. Obzor, Vol. 49, No. 4, 169-73 (1960). In Czech.

In liquid-cooled turboalternators it is important in the design of the stator winding to determine the flow resistance of the ducts, which contain many cross-section constrictions. The flow resistance of straight ducts of rectangular cross section, 8×16 mm^2 and 1 m length was measured at Reynolds numbers varying from 3300 to 38000. The ducts contained constrictions of varying shapes and the most advantageous shape was ascertained. Results of the measurements are tabulated.

N.Klein

621.313.1 : 621.315.613.1

5967 THE INSULATION OF WINDINGS AND THE INCREASE OF PRODUCTION EFFICIENCY OF ELECTRICAL ROTATING MACHINES. B.Červenka.
Elektrotech. Obzor, Vol. 49, No. 4, 186-90 (1960). In Czech.

Discusses the efficiency of manufacture of the insulation in turboalternators, d.c. machines and traction motors. The use of reconstructed mica, called Remica, is considered in particular; this mica is backed by a non-alkaline glass fabric and bonded with an epoxy resin. Mechanization of insulating operations and the cleaning of conductor ends from insulation are described.

N.Klein

621.313.1

5968 THE MAGNETIC FIELD AND CENTRING FORCE OF DISPLACED VENTILATING DUCTS IN MACHINE CORES. K.J.Binns.
Proc. Instn Elect. Engrs, Monogr. 394 U, publ. Aug., 1960, 7 pp. To be republished in Part C.

Examines analytically the field between equal stator and rotor ducts when displaced from each other and evaluates, for any relative position, the total flux crossing the air-gap and the amount entering the sides of each duct. The flux entering the sides of the stator ducts in a.c. machines varies at supply frequency and produces eddy currents the path of which is not restricted by the direction of the laminations and which consequently give rise to considerable loss. With relative displacement of the ducts the fluxes entering the two sides of a duct become unequal and produce an axial magnetic force of engineering importance. Numerical values are given for the variation of gap permeance and magnetic centring force, and are plotted in curves directly applicable to design calculation for ratios of duct to gap width varying from $\frac{1}{2}$ to 5 and for any relative displacement.

621.313.1

5969 A NEW FORM OF THE TENSOR EQUATIONS OF ELECTRICAL MACHINES. G.S.Brosan.
Proc. Instn Elect. Engrs Monogr. 378S, publ. May, 1960. (Vol. 107C, 299-305, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3288 of 1960.

621.313.1

5970 CALCULATION OF STRAY LOAD LOSSES IN D.C. MACHINERY. E.Erdelyi.
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 129-38 (1960) = Pwr Apparatus Syst., No. 48 (June, 1960).

Describes the state of the art as it is presented in published papers dealing with the theory of load losses. The losses are classified according to the location where they occur. The cause of the losses is described and the calculation of losses is reviewed historically. Some of the results are reproduced and a bibliography is added. The bibliography does not claim completeness. It is believed that the most important papers published in the American, English, French and German engineering literature, referring to stray load losses, are quoted. Papers that do not contain any new method, idea, approach, simplification, or test data and are repetitions of publications already among the references are omitted.

621.313.2

5971 DISTRIBUTION OF MAGNETIC FLUXES AND THE COMMUTATING FIELD IN MACHINES WITH THE FULL AND HALF THE NUMBER OF AUXILIARY POLES. I.Z.Ageev.
Elektrichestvo, 1960, No. 3, 38-43 (March). In Russian.

The influence of auxiliary poles on the flux on the main poles of a d.c. generator depends on the number of the auxiliary poles. Operation is described with the aid of formulae for cases when the number of auxiliary poles equals the full number or half the number of the main poles. The effect of load is considered and a method is suggested for construction of the resultant commutating field diagrams. Some conclusions are given on design of machines up to 100 kW using half the number of auxiliary poles.

Z.A.A.Krajewski

621.313.2

5972 THE EFFECT OF THE RIPPLE OF THE D.C. CURRENT ON THE PERFORMANCE OF MOTORS SUPPLIED BY RECTIFIERS. J.Štěpina and J.Bendl.
Prace Ustavu pro Elektrotech. CSAV, No. 9, 123-56 (1958). In Czech.

A qualitative treatment of the increased losses and commutation difficulties is given in the first part. The ripple effect is most marked in the armatures of compensated motors, because of the reduced effective reactance of such armatures. The ripple scarcely effects the field circuit. The additional losses occur mainly in the armature windings and in the iron of the magnetic circuit of the commutating poles. The alternating component of the commutating flux lags the alternating component of the armature current by nearly half a period and hence only motors having a wide black-band will operate satisfactorily from a controlled rectifier supply. Methods for the calculation of additional losses, for the calculation of the alternating component of the flux in the commutating pole magnetic circuit are given. It is also shown how to calculate the transformer voltages in the short circuited coils. Sample calculations are confirmed by experimental results.

E.Erdélyi

621.313.3

5973 ELECTROMAGNETIC PHENOMENA IN FLAT INDUCTION PUMPS FOR LIQUID METALS. N.M.Okhremenko.
Elektrichestvo, 1960, No. 3, 48-54 (March). In Russian.

As compared with an induction motor the induction pump posesses certain distinguishing features. A large air gap leads to low induction and substantial stray fields. Currents in a thick layer of metal produce a demagnetizing (reaction) effect. Superimposed on the running field in the pump there are pulsating fields, caused by the open magnetic circuit and stray coil fluxes, producing a so-called longitudinal edge effect. The limited width of the layer gives rise to an increased current density along the axis of motion — a phenomenon which reduces the available pressure and which is known as the lateral edge effect. The combined influence of the two edge effects is presented against a background of the theory of the induction pump, starting with basic Maxwell's equations. Good agreement (5-15%) is reported between calculation and experiments with a mercury pump model. References are given to twelve (Soviet) papers.

Z.A.A.Krajewski

621.313.3

5974 WINDING FACTOR AND GAP- AND SLOT-LEAKAGE REACTANCE OF FRACTIONAL SLOT WINDING. K.Matsuyama.
E.T.J. Japan, Vol. 5, No. 2, 51-5 (1959).

An analytical investigation with the object of rationalising and simplifying the method given by Liwschitz (Abstr. 732 of 1944). Discrimination is made between windings with an odd or even value of the number of slots divided by the slots/pole/phase. The gap-leakage reactance is calculated and the effect of slot-opening evaluated. An extensive table of coefficients is included. A short bibliography is added.

R.G.Jakeman

621.313.3 : 681.142

5975 SYNTHESIS OF INDUCTION MOTOR DESIGNS ON A DIGITAL COMPUTER. C.G.Veinott.
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 12-18 (1960) = Pwr Apparatus Syst., No. 47 (April, 1960).

A programme for an Alwac III computor is outlined. Given the stator and rotor punchings, the computer will go through an iterative procedure to determine the best stator winding (and if desired stack length) for either single- or double-cage rotors. Samples are given of the forms on which the input data is written

and the form of the output is also shown. Considerable flexibility is allowed in what input data is given and which best winding is desired, e.g., either minimum breakdown torque or maximum locked-rotor amperes depending on which is more important in the particular design case being considered.

G.A.Montgomerie

621.313.3 : 621.316.925

RECENT DEVELOPMENTS IN THE FIELD OF GENERATOR PROTECTION. See Abstr. 5450

621.313.322

5976 CONCRETE STATOR FRAMES OF HYDROALTERNATORS DESIGN AND ECONOMIC STUDY. V.Kořán and V.Břach.
Elektrotech. Obzor, Vol. 49, No. 4, 180-6 (1960). In Czech.

Suggests two alternative designs, which permit different handling of the cement on casting. Both designs make use of rectifying members which take care of differences in the thermal extension of stator iron and concrete. Alternators of both designs are compared with an alternator made with a welded-steel frame and this is illustrated by a calculated example. About 1% cost reduction is expected after installation for an alternator with concrete frame. Against this small saving the impossibility of adjusting the air gap by stator adjustment, and creep in the concrete foundations, weigh heavily. Only transport difficulties of oversize frames might induce the use of concrete frames. N.Klein

621.313.322

5977 CURRENT SURGE ON SELF-SYNCHRONIZATION. Z.Zoubek.
Elektrotech. Obzor, Vol. 49, No. 4, 199-204 (1960). In Czech.

The analysis sets out from the system of equations which generally describe transient processes in synchronous machines. The equations are linearized by assuming constant slip. After further simplifying assumption an involved expression for the current is derived. Experiments on self-synchronization were carried out on a 40 kVA alternater, varying the angle of the rotor, and the measured current was generally found to be in good agreement with that calculated from the derived relation. N.Klein

621.313.322 : 621.317.33

AGEING MEASUREMENTS ON HIGH-TENSION WINDINGS OF SYNCHRONOUS MACHINES. See Abstr. 6062

621.313.322 : 621.316.722

GROUP EXCITATION REGULATION OF HYDRO-ELECTRIC GENERATORS. See Abstr. 5437

621.313.322 : 621.316.933

SURGE PROTECTION OF UNIT-CONNECTED GENERATORS. See Abstr. 5456

621.313.322 : 621.316.722

NEW AUTOMATIC ELECTROMAGNETIC EXCITATION REGULATORS FOR SYNCHRONOUS MACHINES. See Abstr. 5436

621.313.322-81

5978 CENTRIFUGAL STRESSES IN TURBO-ALTERNATOR ROTORS. H.Fessler.
Proc. Instn Mech. Engrs, Vol. 173, No. 29, 717-30 (1959).

The frozen stress photo-elastic technique was used to determine the peak stresses occurring in rotating disks which represented rotor sections. A large range of shapes of winding slots was tested and a simple empirical relationship was obtained from which the peak stresses at the necks of the teeth can be readily calculated. It was shown that these results are directly applicable to steel rotors. Semicircular subslots (inward from the winding slots) and interslots (between the winding slots) reduced the peak stresses. The largest possible cooling slots with semicircular roots are recommended. The stresses in the tips of the teeth due to the thrust of the winding-slot wedges were studied with static models in which the centrifugal force due to the windings was replaced by a tensile force. From these results recommendations were made for the least highly stressed shapes of tooth tips in rotors containing interslots.

621.313.322-82

5979 ECONOMIC REPERCUSSIONS OF THE CHOICE OF THE ELECTRIC PARAMETERS. J.Chatelaine.
Bull. Assoc. Suisse Elect., Vol. 51, No. 7, 347-51 (April 9, 1960). In French.

The effect of power factor and short-circuit ratio on the cost and size of hydroelectric alternators is discussed in detail. The factors limiting power output are summarized. P.Linton

621.313.333 : 621.315.616

5980 INDUCTION MOTORS INSULATED WITH "VETROTEX" AND SILICONES (CLASS H). E.Belloni.
Industr. Itál. elettrotec., Vol. 12, No. 12, 446-51 (Dec., 1959). In Italian.

After a discussion of the losses, efficiency and heating of induction motors, a comparison is made between Class E insulation and glass insulation with silicones (Class H). A short bibliography is added. R.G.Jakeman

621.313.333 : 621.34

SOME DYNAMIC PROBLEMS OF ASYNCHRONOUS ELECTRICAL DRIVES. See Abstr. 6044

621.313.333 : 621.34

SQUIRREL-CAGE AND SLIP-RING MOTORS FOR THE DRIVE OF BRIDGE CRANES AND MOBILE CRANES. See Abstr. 6046

621.313.36

5981 SOME APPROXIMATIVE RELATIONS FOR THE PRELIMINARY DESIGN OF THE ROTOR-FED THREE-PHASE SHUNT COMMUTATOR MOTOR. N.Onjanow.
Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 2, 25-31 (Jan. 15, 1960). In German.

See Abstr. 4420 of 1953. Some of the approximations used in the previous article are now omitted in order to derive the more exact diagram of the compensated motor. The basic relations are discussed, e.g. the dependence of the torque on the secondary active current and of the active current on the slip, the slip at loss-free no-load, the slip difference between no-load and full load, the secondary and primary reactive no-load current. A comparison is made between compensated and non-compensated machines in order to choose the correct compensation, particularly for the Schrage motor taking into account minimum secondary current and the heating of the secondary circuit. By the aid of the relations derived, the behaviour of the machine may be calculated without drawing the circle diagram. R.Neumann

621.313.36 : 621.317.384

5982 BRUSH CONTACT LOSSES DUE TO LOAD AND PARASITIC CURRENTS IN POLYPHASE COMMUTATOR MOTORS. O.E.Mainer.
Proc. Instn Elect. Engrs, Monogr. 375U, publ. April, 1960 (Vol. 107C, 283-7, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3300 of 1960.

TRANSFORMERS

621.314.2

5983 NATURAL OSCILLATIONS OF A [TRANSFORMER] COIL. L.Genov.
Elektrichestvo, 1960, No. 3, 55-9 (March). In Russian.

Previous work on this subject is summarized briefly and a more accurate method is derived for calculation of natural oscillations of an iron-cored coil. A high and constant permeability is assumed in the iron. Transformers with an earthed neutral and with an isolated neutral are considered in detail. An example illustrates a comparison of results obtained by the new method with those from formulae by earlier authors and with experiment. Z.A.A.Krajewski

621.314.2 : 621.3.013 : 538.3

5984 ELECTROMAGNETIC FIELD OF A FERROMAGNETIC TRANSFORMER. V.Bevc.
Amer. J. Phys., Vol. 28, No. 7, 636-7 (Oct., 1960).

It is pointed out that oversimplified pictures of ferromagnetic transformers are not satisfactory from the viewpoint of Maxwell's equations. A simple one-dimensional solution for the electromagnetic field of an ideal ferromagnetic core consistent with the field equations is presented. The author suggests that only such fields be used in introductory courses.

621.314.2

5985 VOLTAGE AND TURN RATIO OF VERY HIGH-VOLTAGE TESTING TRANSFORMERS. B.Paderta.
Elektrotech. Obzor, Vol. 49, No. 4, 191-8 (1960). In Czech.

Investigates the distribution of voltage along transformer windings and the voltage increase due to self-capacitance. In the derivation of the differential equations the resistances are neglected and

the stray inductance is assumed to be uniformly distributed. Solution of the equations gives relations for the voltage distribution and the resonance frequencies of the winding. The relations are in fair agreement with experimental results and the relations are best suited for high-turn-ratio transformers with cylindrical windings.
N.Klein

621.314.2

5986 15 YEARS DEVELOPMENT OF MEASURING TRANSFORMERS IN THE JULIUS FUČÍK ELECTROTECHNICAL WORKS IN BRNO. J.Hanuš.
Elektrotech. Obzor, Vol. 49, No. 5, 227-36 (1960). In Czech.

Describes earlier types with porcelain and hard-paper bushings and newer transformers making use of epoxy-resins. New developments are: (a) magnetic circuit with pre-excitation for cascade type highest voltage current transformers; (b) transformers attachable to station bushings of 100 kV; (c) oil-poor current transformers for 110 and 220 kV; and (c) capacitance instrument voltage transformers of 220 kV.
N.Klein

621.314.2

5987 THE DISTRIBUTION OF IMPULSE VOLTAGES IN TRANSFORMERS WITH INTERLEAVED WINDINGS. V.Gorio.
Elettrotecnica, Vol. 47, No. 2, 78-86 (Feb. 10, 1960). In Italian.

A brief account is given of the equivalent circuit of the transformer windings and the method to determine the distribution of surge voltages. A comparison is made of the impulse strength of conventional and interleaved windings and results quoted of tests carried out on an experimental winding. It is concluded that the interleaved winding offers an increased impulse-withstand level without involving constructional or design difficulties.
M.Rathbone

621.314.2

5988 THE EFFECT OF PERIODIC SHORT-CIRCUIT FORCES ON TRANSFORMER WINDINGS. J.Kulda.
Prace Ustavu pro Elektrotech. CSAV, No. 9, 30-41 (1958). In Czech.

In the determination of mechanical stresses in transformer windings the assumption is made that the short-circuit forces are independent of time. Hence their maximum value is used in the analysis. The analysis is extended to the case of periodic short-circuit forces in order to find their effect on windings and structural components. Equations for the finding of the natural frequencies of the windings and other components in both the radial and axial modes of vibration are established and mechanical stresses during vibration calculated. The dynamic stresses are compared with those caused by static forces. It is shown that the natural frequencies in both radial and axial modes of vibration are much higher than the double of the supply frequency and thus no danger of resonance exists.
E.Erdélyi

621.314.2

5989 CONTINUOUS SINGLE-PHASE SHORT-CIRCUITS BETWEEN TWO TRANSFORMERS. M.Franzl.
Prace Ustavu pro Elektrotech. CSAV, No. 9, 43-63 (1958). In Czech.

In the first part wye–wye connected transformers paralleled on both sides are treated. In one case one transformers secondary neutral is earthed, the neutral of the other transformer is isolated. The short-circuit is supposed to occur between the earthed neutral and one phase. In the second case both secondary neutrals are isolated and the short occurs between one of the isolated neutrals and one phase. In the second part of the paper the case is treated in which each transformer is supplied by a separate generator. The generators are wye-connected, the transformer primaries in delta, the secondaries are in wye and paralleled. Expressions for the phase currents and voltages are developed using symmetrical component methods. From the results it is evident that both transformers feed current into the short-circuit. Account is taken of magnetization currents so that the shift of neutral voltages can be calculated.
E.Erdélyi

621.314.2 : 621.317.33

DIELECTRIC TESTS ON TRANSFORMERS AS INFLUENCED BY FURTHER BIL REDUCTIONS. See Abstr. 5488

621.314.2 : 621.315.611

FACTORS AFFECTING THE AGING CHARACTERISTICS OF VARIOUS WIRE-COATING MATERIALS IN TRANSFORMER OIL. See Abstr. 5482

621.314.223

5990 THE A.C. POTENTIOMETER-A NEW CIRCUIT COMPONENT. L.Robbins.
Electronic Industr.,Vol. 19, No. 3, 120-4 (March, 1960).

Using tape-wound toridal cores autotransformers of moderate size with low winding resistance, high Q, high input impedance, low output impedance and a low phase-shift over a wide frequency range can be made. The application of such devices to computers (where buffer amplifiers can be eliminated), servomechanisms, and as voltage step-up devices is described. It is emphasized that to use these devices to their fullest advantage they must be considered as a new type of component with their own body of application techniques.
A.P.C.Thiele

621.314.223

5991 EQUIVALENT CIRCUIT OF AUTOTRANSFORMERS. J.Chládek.
Elektrotech. Obzor, Vol. 49, No. 5, 256-60 (1960). In Czech.

Autotransformers are again being considered for maximum voltages and powers owing to simpler production and transport. The equivalent T-circuit of the autotransformer and the expression for its impedance are derived. The latter is compared with that of a two-winding transformer and it is shown that factors for referring impedances from primary to secondary differ.
N.Klein

621.314.224

5992 COMPLEX DIAGRAM OF THE ERRORS OF A MEASURING CURRENT TRANSFORMER AND ITS APPLICATION. J.Kopeček.
Elektrotech. Obzor, Vol. 49, No. 4, 173-9 (1960). In Czech.

Based on Moellinger's earlier work derives the complex diagram of errors, discusses its accuracy and compares this diagram with the complex magnetization curve; the diagram differing from the latter only by rotation of the coordinate system and by the scale. The application of the diagram to the solution of several design problems of current transformers is shown including change of the burden, change of the mean length of the magnetic circuit, and change of the class of accuracy.
N.Klein

621.314.224 : 621.317.313

TECHNIQUES FOR THE CALIBRATION OF STANDARD CURRENT TRANSFORMERS UP TO 20 kc/s. See Abstr. 5486

POWER CONVERSION

621.314.58 : 621.314.2

5993 HIGH-VOLTAGE GENERATION BY SMALL POWER TRANSFORMERS. P.V.Timofeev and Yu.A.Simchenko.
Elektrichestvo, 1960, No. 1, 38-42 (Jan.). In Russian.

A theoretical and experimental investigation of the effects of interrupting direct current in slightly damped coupled coils. The optimal conditions for achieving maximum transient voltage on the secondary terminals are established, and its magnitude is computed. The influence of coupling factor is discussed. Four references.
P.Szekely

621.314.63

5994 ON THE CALCULATION OF FULL-WAVE RECTIFIER CIRCUITS. L.A.Sinitskii.
Elektrichestvo, 1960, No. 1, 68-72 (Jan.). In Russian.

Formulae for half-wave circuits were obtained in previous works (see Abstr. 5706 of 1958 and 6982 of 1959). An equivalent circuit comprising one rectifier is developed for both bridge and centre-tapped configuration, so that previous results can be applied. An example is given. Four references.
P.Szekely

621.314.63 : 621.316.718.5

FIELD-CURRENT CONTROL WITH SHUNTED RECTIFIERS. See Abstr. 6014

621.314.63 : 621.317.725

PORTABLE DIRECT-READING VOLTMETER FOR ARC-DROP MEASUREMENT. See Abstr. 6084

621.314.63

5995 SILICON RECTIFIERS FOR LARGE POWER. J.Vinopal and G.Píša.
Elektrotech. Obzor, Vol. 49, No. 5, 268-71 (1960). In Czech.

Describes development work for rectifiers of 100 A and more.

P^+–N–N^+ junctions are used and the current density at 600 V reverse-voltage is less than 1 mA/cm². Report of samples with 1800 V reverse-voltage and 100 μA/cm² reverse-current density are given. Manufacturing methods and characteristic properties are given.

N.Klein

621.314.63 : 621.382.333.3

5996 THE DESIGN OF CONTROLLED RECTIFIERS USING TRIODE TRANSISTORS. E.E.Ward.

Proc. Instn Elect. Engrs, Paper 3281 E, publ. Sept., 1960 (Vol. 107B, 473-80).

Deals with polyphase rectifiers in which the switching element is a complementary combination of a p-n-p and an n-p-n transistor. The stability conditions for the open and closed states of this switch are investigated graphically, leading to the calculation of the voltage drop when conducting. There is a sharp upper limit to the permissible current. Tests are described on a 3-phase controlled rectifier.

621.314.63

5997 AN ANALYSIS OF VOLTAGE MULTIPLYING RECTIFIER CIRCUITS. V.M.Kantor.

Radiotekhnika, Vol. 15, No. 5, 55-9 (May, 1960). In Russian.

Formulae for the operation of voltage-multiplying rectifiers are derived, assuming; (a) a capacitive load, with time constant large relative to the period of the a.c. source; (b) a resistive a.c. source; (c) constant diode forward-resistance; (d) zero diode phase-shift. The disagreement between calculated and experimental results for a four-stage Se diode rectifier did not exceed 10%.

F.Quelon

621.314.63 : 621.357

APPLICATIONS OF SEMICONDUCTOR RECTIFIERS IN LARGE AND MEDIUM POWER ELECTROCHEMICAL INSTALLATIONS. See Abstr. 5581

621.314.65 : 621.387

BEHAVIOUR OF THE ION-SHEATH DURING THE DEIONIZATION PROCESS IN MERCURY-ARC RECTIFIER. See Abstr. 6323

621.314.653

5998 TRANSIENT BEHAVIOUR OF CONTROLLED RECTIFIERS FEEDING EXCITING COILS OF ELECTRIC MACHINES. L.Vitályos.

Acta tech. Hungar., Vol. 28, No. 1-2, 87-110 (1960).

Developes an equation for the inductive load current as a function of time for a rectifier with a constantly changing firing angle. The equation was applied to a single-phase symmetrical full-wave circuit, first in the steady state, then with the firing angle varying; the conditions giving best operation were derived. The universal application of the formula was demonstrated by applying it to a non-symmetrical single-phase circuit. 10 references.

E.F.Hansford

621.314.653

5999 THE EMPRETRON, A MERCURY POOL ARC TUBE ALLOWING OPERATION AT REPETITION RATES IN THE KILOCYCLE RANGE. K.G.Hernqvist and F.H.Norman.

Trans Amer. Inst. Elect. Engrs I, Vol. 79, 85-91 (1960) = Commun. and Electronics, No. 48 (May, 1960).

The Empretron is a new mercury-pool arc tube for switching applications. The arc between the mercury-pool cathode and the main anode is initiated by a vacuum spark. The spark discharge occurs between two continuously replenishable electrodes, one being an electrode partly immersed in the mercury pool and the other, the starter electrode, a mercury reservoir supported above the mercury pool. Starting is accomplished by applying a high-voltage pulse to the starter electrode. The resulting spark discharge develops into an arc between the cathode and the main anode. The minimum energy necessary for arc initiation, 10^{-3} to 10^{-2} joules per start, is determined by the stray capacitance between the starter electrode and the mercury pool. Operation at repetition rates up to 5 kc/s has been demonstrated. This is about one order of magnitude higher than the upper limit of 400 c/s for the conventional ignitron. Because of a materials problem resulting from the requirement that the outside of the starter electrode remain unwetted by mercury, the present tube design is limited to operation at relatively low duty cycles for the main arc. The main use of this device is therefore in pulse modulator service.

POWER TRANSMISSION
OVERHEAD LINES . CABLES

621.315.051

6000 EXTRA-HIGH-VOLTAGE TRANSMISSION. J.R.Mortlock.

Trans S.African Inst. Elect. Engrs, Vol. 50, Pt 7, 184-200 (July, 1959).

A short comprehensive review of present trends in e.h.v. transmission. An extensive bibliography and interesting discussion are included.

A.P.Wilmshurst

621.315.1

6001 FEATURES OF CONDITIONS ON HEAVILY LOADED ELECTRICAL TRANSMISSION LINES. G.M.Sekhniashvili.

Elektrichestvo, 1960, No. 4, 42-6 (April). In Russian.

A simplified form of investigation into the power conditions of transmission lines is described in which account is taken of the technical and economic considerations involved in running lines near to their maximum handling capability. Terms for line efficiency, power loss, reactive VA compensation etc. are obtained as functions of two factors characteristic of the operating conditions; namely, reactive/active power ratio and utilization factor (actual power/maximum). As an example, an existing 110 kV line is analysed, and the conclusion drawn that the line power should not exceed 85-90% of the maximum possible, even under emergency conditions.

J.H.B.Gould

621.315.145

6002 FIVE EXPANDED A.C.S.R.CONDUCTORS SELECTED FOR 460 kV PROTOTYPE LINE.

P.L.Lumnitzer, N.K.Barr and R.E.Larson.

Elect. Wld, Vol. 153, No. 25, 88-90 (June 20, 1960).

Five conductors will be tried on the 460 kV prototype line built by Pennsylvania Electric Co. and to be energized in 1960. Four are of a type which has been used on lines up to 345 kV, the expanding medium being paper filler twine; the fifth has aluminium tubes as expanding medium. Diagrams show make-up of the conductors and brief particulars are given of structures, spacings and proposed methods of stringing.

A.P.Wilmshurst

621.315.2 : 621.315.616

REINFORCED ZIEGLER POLYETHYLENE PIPES. See Abstr. 6054

621.315.211.2

6003 A BASIS FOR SHORT-CIRCUIT RATINGS FOR PAPER-INSULATED CABLES UP TO 11 kV.

L.Gosland and R.G.Parr.

Proc. Instn Elect. Engrs, Paper 3314 S, publ. Aug., 1960, 14 pp. To be republished in Vol. 108 A (1961).

The various factors which may determine the short-circuit rating of paper-insulated cables are examined, and individual limits are proposed for each which may be decisive. These are the temperature rise of the conductors, the sheath temperature and the peak current. The application of these limits to a range of cables is illustrated.

621.315.211.4 : 621.395.741

TERMINAL ACCESSORIES FOR GAS-PRESSURE MONITORED LONG-RANGE AND JUNCTION CABLES. See Abstr. 5755

621.315.221.8

6004 STEEL/POLYETHYLENE AND ALUMINIUM/POLYETHYLENE SHEATHS FOR TELECOMMUNICATIONS CABLES. H.Haselhorst.

Siemens Rev., Vol. 27, No. 4, 103-7 (May, 1960).

English translation of paper already abstracted as Abstr. 5064 of 1959.

621.315.28

6005 PRESSURE AT THE INTERFACE OF INNER CONDUCTOR AND DIELECTRIC OF ARMORLESS OCEAN CABLE. P.G.Bhuta.

Bell Syst. tech. J., Vol. 39, No. 4, 963-72 (July, 1960).

Pressure at the interface of the inner conductor and the dielectric of the armourless ocean cable is experimentally determined for plane stress boundary conditions. Polyethylene outer and steel inner concentric cylinders are considered as a mechanical model of the ocean cable. Equations are derived to give the pressure

at the interface for plane stress and plane strain conditions. It is found that the theoretical values of the pressure calculated from equations of elasticity are in good agreement with experimental values, even when one of the materials is polyethylene, which has a nonlinear stress–strain relationship in simple tension or compression. From previously measured values of bulk and Young's moduli, it is shown that, for an elastic analysis, Poisson's ratio for polyethylene is very nearly 0.5. An experimental verification of the plane stress solution given in the paper confirms the foregoing value.

DISTRIBUTION . INSTALLATIONS

621.316.1

6006 SINGLE WIRE EARTH RETURN HIGH VOLTAGE DISTRIBUTION FOR VICTORIAN RURAL AREAS. J.L.W.Harvey, H.K.Richardson and I.B.Montgomery. Instn Engrs, Austral., elect. mech. Engng Trans, Vol. EM1, No. 1, 1-11 (May, 1959).

The single wire earth return system of high voltage distribution, applied first in New Zealand, has been used to supply a number of rural areas in the distribution system of the State Electricity Commission of Victoria. The paper covers the economics of the system as compared with standard distribution methods, the design and construction of single wire lines and associated substations, factors affecting the choice of voltage, conductor size, etc., co-ordination with telecommunication lines, protection methods, and some special features associated with the use of the earth as return conductor. The results of tests on completed lines to check design data are also discussed.

621.316.1 : 621.316.728

THE AUTOMATIC CONTROL OF REACTIVE POWER IN THE NETWORK. See Abstr. 5443

621.316.11

6007 SIMPLIFICATIONS IN THE CALCULATION OF THREE-PHASE CURRENTS. A.Jung. Electricien, Vol. 88, 131-3 (July, 1960). In French.

An analytical discussion of the neutral current in a star system with unequal loads, also the currents in the branches of a 3-wire 3-ph. system with unequal 1-ph. loads. Numerical examples are given. R.G.Jakeman

621.316.11

6008 RECALCULATIONS OF SHORT CIRCUIT CURRENTS. G.G.Kostanyan. Elektrichestvo, 1959, No. 11, 73-76 (Nov.). In Russian.

The determination of short-circuit currents in a complex mesh involves a considerable amount of work. With the growth of the system and change of conditions it may be necessary to recalculate currents and voltages at various parts of the mesh. A means of avoiding complete recalculation of the mesh is given in which the results obtained on the existing mesh are used in recalculating for the revised conditions. The recalculation is independent of the complexity of the existing mesh. The derivation of the necessary equations is described and illustrated by a worked example. J.S.Wilson

SWITCHGEAR

621.316.5

6009 THE ALTERATION OF CONTACT SURFACES AT HIGH TEMPERATURES. A.Wollenek. Z. angew. Phys., Vol. 12, No. 8, 360-4 (Aug., 1960). In German.

A theoretical discussion of the progressive changes which affect the resistance of electrical contacts, with detailed experimental results for contacts made of copper and of silvered copper, under various conditions of temperature and of contact pressure. P.M.Davidson

621.316.5 : 621.387

ON THE EFFECT OF THE GUIDE-BAR FIELD ON THE DEVELOPMENT AND MOVEMENT OF ARC SPOTS. See Abstr. 6316

621.316.57

6010 FORCE, DISTANCE AND VELOCITY MEASUREMENTS ON A CONTACTOR. O.Loh. Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 7, 149-54 (April 1); No. 8, 170-3 (April 15, 1960). In German.

An experimental investigation into the kinematics of a magnetically operated switchgear mechanism. The evaluation of solenoid pull-in force is considered in detail and the effect of phase timing in a.c. solenoids is discussed. Measurements on closing and opening strokes were carried out for different phase timings, both distance and speed being measured. The impact energy on contact make was checked by means of calibrated lead spheres whose deformation was measured. This article represents an important contribution to the analysis of solenoid-operated mechanisms. P.Linton

621.316.57

6011 NEW KNOWLEDGE IN THE FIELD OF H.V. SWITCHING APPARATUS. R.Mihula. Elektrotech. Obzor, Vol. 49, No. 5, 236-43 (1960). In Czech.

Study of switching processes lead to developments which are described e.g. new air-blast circuit-breakers for 10 to 35 kV, a 2000 MVA circuit-breaker for generators, and new oil circuit-breakers. N.Klein

621.316.57

6012 NEW SERIES OF MEDIUM SIZE PROTECTIVE SWITCHES. V.Večerka and A.Plotěný. Elektrotech. Obzor, Vol. 49, No. 5, 250-5 (1960). In Czech.

After discussing design principles describes the new switches. Contact system, burning tips and extinguishing system are treated in detail. An overcurrent short-circuit tripper and the mechanical system are described. Merits of the switches are discussed. N.Klein

621.316.57 : 621.317.2

TEST METHODS AND EQUIPMENT FOR TESTING H.V. CIRCUIT-BREAKERS. See Abstr. 6059

REGULATION

621.316.718 : 621.34

6013 THE REGULATION OF MULTI-MOTOR DRIVES. A.Theuer. B.B.C. Nachr., Vol. 42, No. 5, 251-8 (May, 1960). In German.

The drives dealt with are such as used for paper machinery and are limited to d.c. A progressive review is made of the types of regulation required, starting with plain speed-regulation. As more accuracy is desired, additional types are developed such as: (a) load-sharing; (b) number of revs.; and (c) angle and position regulation. Many diagrams of connections and graphs are given. The basic scheme may either be by armature or field regulation. A short bibliography is added. R.G.Jakeman

621.316.718.5 : 621.34

CONSTANT-SPEED SERIES GENERATOR SERIES MOTOR DRIVE. See Abstr. 5478

621.316.718.5 : 681.142

ANALOGUE SIMULATION FOR THE SPEED CONTROLLER OF THE LATINA POWER STATION CO_2 BLOWERS. See Abstr. 5924

621.316.718.5 : 621.314.63

6014 FIELD-CURRENT CONTROL WITH SHUNTED RECTIFIERS. H.Christensen. Elektrotek. T., Vol. 73, No. 15, 249-54 (June 5, 1960). In Norwegian.

Rectifier control with an inductive load is considered with reference to the control of a Ward Leonard system in which the field of the main generator is controlled by means of a rectifier (thyratron or controlled semiconductor rectifier). A theoretical study is made of the magnitude of the rectified current through an inductance fed from an a.c. source through a controlled rectifier, the inductance being shunted by a non-controlled rectifier to facilitate d.c. build-up The problem is investigated for various loss angles of the inductance and for several firing angles of the controlled rectifier. Experimental results show broad agreement with theory. G.N.J.Beck

621.316.72 : 621.319.523

6015 ELECTRONIC STABILIZATION OF THE COCKROFT AND WALTON GENERATOR AT THE ECOLE ROYALE MILITAIRE. G.Dome and H.d'Hoop.
Rev. H.F., Vol. 4, No. 9, 215-20 (1960). In French.

The generator, which is part of the injector for a helix linear accelerator, is stabilized by means of a 60 kV series triode. The error signal is derived from two resistance chains and is transmitted to the triode by modulation of a beam of light. Preliminary experiments on a 100 kV machine showed a reduction in the amplitude of the fluctuations by a factor of twenty. E.A.Ash

621.316.721 : 538.1

6016 A STABLE CURRENT SOURCE FOR A LABORATORY ELECTROMAGNET. P.Pilod.
C.R.Acad. Sci. (Paris), Vol. 250, No. 26, 4319-21 (June 27, 1960). In French.

The source consists of a dynamo and four transistor stages. Temperature compensation is arranged by the use of a selected Zener diode. More than 4 kW is available with a measured stability of 2 in 10 000 over a half-hour period. C.A.Hogarth

621.316.721 : 621.327.534

IMPROVED MERCURY LAMP TRANSFORMER FOR MAXIMUM REGULATOR LOADING ON SERIES CIRCUITS.
See Abstr. 5556

621.316.722

6017 AUTOMATIC VOLTAGE REGULATION USING THE CAPACITANCE OF A P–N JUNCTION AS THE NON-LINEAR DETECTING DEVICE. L.S.Berman.
Elektrichestvo, 1960, No. 1, 88-9 (Jan.). In Russian.

A brief account, with circuit but without component values, of a regulator for very low d.c. voltages. A photo-diode in one arm of a 5 kc/s bridge is the controlling element. The stabilization factor is 120 at 0.44 V output. F.Quelon

621.316.722 : 621.313.322

6018 MEASUREMENT AND CONSTRUCTION OF CHARACTERISTIC CURVE FOR VOLTAGE REGULATION OF SYNCHRONOUS GENERATORS AND TRANSFORMERS. G.Hosemann.
Elektrotech. Z. (E.T.Z.) A, Vol. 81, No. 7, 274-81 (March 28, 1960). In German.

Characteristics of various types of voltage regulator and methods of measuring the regulated voltage are given. With large generator units, the aim is to obtain regulation giving constant mutual voltage components of the line voltages. Generator connected to the network through a step-up transformer can be regulated astatically. For a single generator connected to the system via a low impedance, the regulator with a static characteristic should be used. Operation of several generators in parallel with prescribed reactive load sharing is possible by current regulation in the measuring circuit of the voltage regulator (control of characteristic). The usual method for system transformers is voltage regulation with line drop compensation correcting for distribution volt drop. For identical transformers operating in parallel a single common regulator can be used. If however transformers have different voltage taps, it maybe necessary to fit separate regulators.
W.J.Grek

621.316.722.1 : 621.313.322

6019 VOLTAGE STABILIZATION IN PERMANENT-MAGNET SYNCHRONOUS GENERATORS. P.Gozzoli.
Elettrotecnica, Vol. 47, No. 5, 333-8 (May 10, 1960). In Italian.

The application of permanent magnet alternators has in the past been restricted due to poor voltage regulation; a method of compensation is described which has been in service for some years and is designed to improve the machine characteristics. An account is given of the equivalent circuit and the compensating arrangements of the machine theoretically determined under leading, lagging and short-circuit conditions. The transformer–capacitor network utilized has the advantage of simplicity without involving the use of additional slip rings, brush gear, or exciters; the system can be utilized to best advantage at frequencies from 400 to 1000 c/s.
M.Rathbone

621.316.722.1

6020 TRANSISTOR-STABILIZED POWER SUPPLIES. W.Larass.
Elektron. Rdsch., Vol. 14, No. 2, 51-5 (Feb., 1960). In German.

Discusses basic principles underlying stabilized power supplies using Zener diodes and transistors, including their advantages and limitations. Factors causing output-voltage fluctuations are discussed. A detailed mathematical treatment for the design of a series-stabilized circuit is given. Finally a complete practical circuit is described, giving a continuously variable output voltage between 7 and 30 V and a maximum load current of 300 mA. Three references.
M.Goldberg

621.316.722.1

6021 SERIES-REGULATED TRANSISTORIZED POWER SUPPLY. M.Nagata, Z.Abe and T.Kinoshita.
J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 2, 173-80 (Feb., 1960). In Japanese.

Detailed theoretical and experimental studies are described of a transistorized power supply in which power transistors are used as a series variable-impedance element. In order to obtain the best stability, the error amplifier used must have high gain and its drift, referred to its input, must be kept as low as possible. Its supply voltage must also be stabilized, and stability of the reference voltage is essential. The frequency response and the power-handling capability of this type of power supply depends mainly on the characteristics of the power transistor used as the series element. Much attention must be paid to the wiring configuration in order to obtain a low output impedance. A practical supply unit is described which has a better temperature coefficient than the cadmium-saturated standard cell and also a smaller output impedance than the lead-acid storage battery of the same voltage. A detailed circuit diagram of this unit is given. A.Wilkinson

621.316.728

6022 APPLICATION OF HIGH-EFFICIENCY PUSH-PULL MAGNETIC AMPLIFIER TO TORQUE CONTROL OF D.C. MOTORS IN TRANSIENT PROCESSES. A.Danthine.
Bull. Sci. Assoc. Ingen. Montefiore (A.I.M.), Vol. 75, No. 1, 75-91 (Jan., 1960). In French.

An application of a magnetic amplifier circuit due to Boyajiau (see Abstr. 968 of 1959). The high-efficiency amplifier is used to feed the armature of a shunt motor, and with a feedback winding carrying the armature current the torque is practically constant and proportional to the control current for speeds of up to 90% of maximum. The theory is given and discussed. Experimental confirmation is claimed. A.K.Podkolinski

621.316.728 : 621.311.161

AUTOMATIC REGULATION OF THE TRANSMITTED ELECTRICAL POWER IN ENERGY SYSTEMS. See Abstr. 5950

621.316.728 : 621.311.161

ANALYTICAL REVIEW OF POWER-SYSTEM FREQUENCY, TIME AND TIE-LINE CONTROL. See Abstr. 5951

621.316.728 : 621.327.534

CONSTANT-VOLTAGE BALLAST FOR TWO OR MORE MERCURY LAMPS. See Abstr.5555

PROTECTION

621.316.91

6023 SELECTION OF FUSE RATING AND ADJUSTMENT OF SWITCHGEAR SETTINGS IN INDUSTRIAL SUB-STATIONS. I. C.Chaumier.
Electricien, Vol. 88, 141-3 (July, 1960). In French.

Simple rules are given for the choice of fuse and overload-trip settings in substations with several outgoing feeders. To ensure selectivity the trip should be set 10% above the maximum total load consisting of fusing current (1.5 I) of heaviest load, overload current (1.4 I) of next heaviest load, and rated value (I) of remaining loads.
P.Linton

621.316.923 : 621.313.333

6024 SURVEY OF INDUCTION MOTOR PROTECTION.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 188-92 (1960) = Pwr Apparatus Syst., No. 48 (June, 1960).

621.316.925

6025 IMPROVED PROTECTION OF 4-kV FEEDERS ON THE BALTIMORE GAS AND ELECTRIC COMPANY SYSTEM. W.W.Ward, Jr.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1828-33 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

The plunger-type relays originally provided to protect the

system described had to be replaced by inverse-time-delay phase relays with delayed reclosure features instead of instantaneous reclosure as feeder loads increased. These relays were later supplemented by inverse-time-delay earth relays to cater for remote earth faults. However, statistics showed that only a small percentage of breakers reclosed automatically without loss of load and high-speed initial-tripping relays were introduced in addition to increase the restoration of service rate. Only one feeder-breaker reclosure is provided normally although certain rural feeders are provided with two reclosures. The second reclosure has, however, not given rise to any appreciable improvement with regard to service restoration. A.S.Hay

621.316.93

6026 THE METHODS OF CALCULATING SURGE DIVERTER DISCHARGE CURRENT RESULTING FROM A NEAR DIRECT STROKE. J.L.Maksiejewski.

Rozprawy elektrotech., Vol. 5, No. 1, 53-65 (1959). In Polish.

Theoretical work by K.Berger (Abstr. 1642 of 1942) is extended by analyzing the case in which the incident current wave is assumed to arrive from a lightning channel of Z_0 characteristic impedance. The expressions for the max. diverter current and the time after which this maximum occurs are derived and compared with those obtained previously using a numerical example. E.M.Dembinski

621.316.933

6027 RELATED CHARACTERISTICS OF LIGHTNING ARRESTERS. J.A.Calion.

J. Instn Engrs Australia, Vol. 31, No. 9, 233-4 (Sept., 1959).

The results of tests specified by typical National Standards enable three characteristic curves, viz., the sparkover voltage–time, the residual voltage–current, and the current–time curve to be drawn for a lightning arrester. Examination of these curves for various arresters should help a prospective purchaser to decide which arrester is best suited to his system conditions. E.M.Dembinski

621.316.933.6

6028 A NEW THREE-ELECTRODE GAS-FILLED TELECOMMUNICATIONS LINE PROTECTOR. R.D.Jones.

A.E.I. Engng Rev., Vol. 1, No. 1, 10-17 (May, 1960).

621.316.98 : 551.5

6029 SOME ASPECTS OF LIGHTNING ACTIVITY AND RELATED METEOROLOGICAL CONDITIONS.

M.Brook and N.Kitagawa.

J. geophys. Res., Vol. 65, No. 4, 1203-10 (April, 1960).

Lightning statistics are used to define a thunderstorm activity index. The index is based upon (1) the total duration and (2) the frequency of occurrence of lightning discharges. It is suggested that the horizontal extent of a storm may be inferred from the shape of the frequency-distribution curve, whereas the mean duration of discharges is related to the vertical convective activity. The bipolar thunderstorm model of Holzer and Saxon [J. geophys. Res., Vol. 57, 207-16 (1952)] is extended to account for the occurrence of multiple discharges to ground. A relationship between the number of intracloud discharges and the total number of separate return strokes in ground discharges may be predicted from the model. Good agreement is found with the predictions in some, but not all, storms. Statistics are cited which suggest that the ratio of intracloud to cloud-to-ground discharges may reflect the type of storm (e.g. "frontal" or "local air mass").

621.316.98 : 551.5

6030 A COMPARISON OF INTRACLOUD AND CLOUD-TO-GROUND LIGHTNING DISCHARGES.

N.Kitagawa and M.Brook.

J. geophys. Res., Vol. 65, No. 4, 1189-1201 (April, 1960).

Lightning discharges were investigated with high time-resolution equipment on both electric-field and electric-field-change meters. Analysis of the electrical records reveals that the late stages of intracloud discharges are very similar to those of cloud-to-ground discharges during the periods between successive return strokes (junction process) and during the period after the last return stroke (final process). In contrast, the initial portion of the field change of an intracloud discharge bears little or no resemblance to the initial portion of the leader field change of a discharge to ground. It is suggested that the difference in the initial breakdown characteristics results from variations in the relative populations of water drops and ice particles as they affect the internal impedance of the region of cloud where breakdown occurs. The difference in the initial field-change characteristics of intracloud and cloud-to-ground discharges is so distinct that from the first 10 ms of the electric-field-change record one can predict with over 95% certainty whether a discharge will reach ground or remain within the cloud.

621.316.98 : 551.5

6031 A CONTRIBUTION TO THE ELECTROSTATIC THEORY OF A LIGHTNING DISCHARGE. H.W.Kasemir.

J. geophys. Res., Vol. 65, No. 7, 1873-8 (July, 1960).

The electrostatic treatment of the field and charge distribution of a lightning discharge leads to the result that the charge distribution of a lightning stroke is composed of (1) the influence charges induced by the electric field of the thundercloud with the net charge zero, and (2) the net charge, which results from the potential difference of the lightning stroke and the ground before the lightning hits the ground. The first kind of charge distribution is that of a cloud discharge and that of the first leader of a ground discharge. The second kind of charge distribution is a feature of the main or return stroke of a ground discharge only. It is the charge distribution of a charged body and independent of the field distribution in the thundercloud. The well-known electrodynamic theory of transients on a transmission line can therefore be applied to the return stroke.

621.316.98 : 551.5

6032 OBSERVATIONS OF ELECTRIFICATION AND LIGHTNING IN WARM CLOUDS.

C.B.Moore, B.Vonnegut, B.A.Stein and H.J.Survilas.

J. geophys. Res., Vol. 65, No. 7, 1907-10 (July, 1960).

An isolated warm cumulus cloud that never attained the altitude of the 0^0 C isotherm was observed to produce four strokes of lightning.

621.316.98 : 551.5

6033 ELECTRIC-FIELD CHANGES AND THE DESIGN OF LIGHTNING-FLASH COUNTERS.

M.Brook and N.Kitagawa.

J. geophys. Res., Vol. 65, No. 7, 1927-31 (July, 1960).

Examples of electric-field and field-change records of lightning discharges are discussed in relation to the design of lightning-flash counters. Correlations between stroke counts and visual observations of nocturnal lightning were found to be very poor for a stroke counter that operates on the abrupt-field-change principle. The abrupt field changes of both signs that accompany all lightning discharges make it virtually impossible to discriminate between ground and cloud flashes with stroke counters of the conventional type. A reliable total count for nocturnal lightning of both types can be obtained with a photomultiplier tube. A photomultiplier operated in coincidence with an electric-field-change meter can be utilized to discriminate against sferics and man-made interference. Conversely, if the photomultiplier and field-change meter are operated in anticoincidence, a trigger system can be constructed which will accept only sferics that originate from outside the area of visible lightning discharges.

621.316.98 : 551.5

6034 BALL LIGHTNING AS A PHYSICAL PHENOMENON. E.L.Hill.

J. geophys. Res., Vol. 65, No. 7, 1947-52 (July, 1960).

Ball lightning has not been produced in the laboratory as yet, but its existence as a real natural phenomenon seems to be assumed. The evidence concerning its physical nature is reviewed in the light of known information on atmospherice electricity and the lightning discharge. It is concluded that it is unlikely that ball lightning is a plasma phenomenon, as it is frequently assumed to be. More probably it is a region containing a strongly inhomogeneous distribution of space charge in the form of highly ionized gas, the ionization being primarily in the molecular form, with few free electrons. Occluded material such as dust, water vapour, and combustible gases may play a significant role in its behaviour.

621.316.98 : 551.5

6035 SOME ELECTROSTATIC CLOUD-DROPLET COLLISION EFFICIENCIES. J.D.Sartor.

J. geophys. Res., Vol. 65, No. 7, 1953-7 (July, 1960).

621.316.98

6036 LIGHTNING RISK AND LIGHTNING PROTECTION. D.Müller-Hillebrand.

Tekn. T., Vol. 90, No. 23, 625-31 (June 3, 1960). In Swedish.

Factors increasing the risk of lightning strokes are discussed and an equation is given for the attraction area of a house, in terms

of its height and the attraction distance, the distance over which lightning will affect an object on the ground. A recent case of a stroke to a birch tree and its continuation via a 35 m earth furrow to a house is described. Fires due to lightning in Sweden during 1954–58 are shown. The value of lightning conductors is examined, statistics showing an 88.7% efficiency of protection to be an acceptable figure. The lightning protection of small houses is discussed; with 95% safety a 6 mm² copper conductor for lightning currents up to 70 kA should suffice. G.N.J.Beck

621.316.99

6037 NEW EARTHING AND SHORT-CIRCUITING DEVICES FOR 110 kV AND 220/380 kV OVERHEAD LINES. H.Müller.
Elektrizitätswirtschaft, Vol. 58, No. 23, 800-3 (Dec. 5, 1959). In German.

Experience gained with existing devices has led to considerable improvements in design. New devices are described, which not only meet the V.D.E. specifications, but also ensure greater safety. On lines up to 110 kV, small projecting earthing bolts are attached to existing line fittings or to auxiliary line clamps. With these bolts it is easier to make a reliable electrical contact to the line. This is made by means of an insulated rod carrying a screw-tightened earthing clamp to which the flexible short-circuiting conductor is connected. The rod is fixed to, and can be disengaged from, the earthing clamp by bayonet connector. Another special type of clamp is used to join the three flexible short-circuiting conductors to one point on the metal work of a tower cross-arm. On new mast structures, special terminations may be provided for these conductors. On 220/380 kV lines, existing portable short-circuiting and earthing devices are excessively cumbersome in use. A pivoting aluminium arm is described, which may be mounted on the cross-arm of a tower. It is arranged so that it may be swung down to make a reliable electrical contact with the overhead line conductor. A split cover clamped to the conductor prevents it from being damaged. The position of the short-circuiting arm can be seen from a distance. E.W.Golding

621.316.99

6038 AN ASSESSMENT OF EARTHED INSTALLATIONS, PARTICULARLY THOSE WITH A DIRECTLY EARTHED STAR POINT. G.Hosemann and D.Oeding.
Elektrizitätswirtschaft, Vol. 59, No. 8, 213-18 (April 20, 1960). In German.

The "earth voltage", between an earth connection and true earth, is theoretically determined for various possible fault conditions on 3-ph., high-voltage equipment. To achieve this the short-circuit earth current and the effective impedance of the fault circuit are first obtained; the former by using a nomogram based on information in a paper previously published by Hosemann [B.B.C. Nachr., S 255 (1958)]. Sample calculations are given. Voltages, expressed as a percentage of the "earth voltage", which could be experienced by persons touching or walking near earthed towers or transformer tanks are tabulated. T.R.Foord

621.316.995

6039 DESIGN AND MEASUREMENT OF BOUNDED EARTHS. A.J.Pesonen.
Kraft o. Ljus, Vol. 33, No. 5-6, 104-11 (May-June, 1960). In Swedish.

The equivalent diameter of the bounded earths (earthing electrodes) described does not exceed 100 m. Their behaviour is discussed in particular with respect to lightning currents. Corona diameters are shown for an earthing electrode at the surface and at depths down to 10 m. Tables are given for the specific resistance of various types of soil, concretes and waters and for the distribution of the earth resistance in the neighbourhood of an earth electrode lying at the surface. Formulae are given for the earth resistance of 18 different arrangements of electrons, varying in geometrical shape and in position relative to the surface. G.N.J.Beck

TRACTION . DRIVES

621.331

6040 ELECTRIC TRACTION ON THE GERMAN FEDERAL RAILWAYS IN THE YEAR 1959. W.Kittsche.
Elekt. Bahnen, Vol. 31, No. 1, 1-8 (Jan., 1960). In German.

An illustrated survey on the progress of electrification which was not quite as fast as during the preceding year. A line length of 273 km was commissioned while a further 327 km are under construction and expected to be commissioned during 1960–61. Of a total of 641 electric locomotives 439 were delivered. A special feature is a double-frequency locomotive fitted with silicon rectifiers which is to be used in the Saar district where the French 50 c/s and the German $16\frac{2}{3}$ c/s systems meet. A great number of tests concerning different aspects of operation were performed on lines and in laboratories. The German Federal Railways collaborated with other national and international organisations in working out and publishing various regulations concerning the construction and operation of traffic systems. R.Neumann

621.332.5

6041 CALCULATION OF RAIL CIRCUITS ALLOWING FOR STATION TRACKS. D.B.Lomazov.
Elektrichestvo, 1960, No. 3, 64-7 (March). In Russian.

The presence of adjacent lines and additional station tracks greatly influences the electrical characteristics of a line by increasing the stray earth currents and reducing the line resistance. An equivalent circuit is derived and calculations are compared with some experimental results on a sector, where the total shunting effect brought about 108% increase in the stray current. Present (Soviet) recommendations for design practice are criticized in the light of the findings. Z.A.A.Krajewski

621.335.2

6042 THE NEW Ae 8/8 LOCOMOTIVE No. 271 OF THE BERN-LÖTSCHBERG-SIMPLON RAILWAY. M.Hauri.
Elekt. Bahnen, Vol. 30, No. 12, 282-3 (Dec., 1959). In German.

A brief illustrated description of this locomotive which is capable of drawing a load of 900 t on a line having slopes of up to 2.7%. The locomotive was developed by short-coupling two existing locomotives of type Ae 4/4. Two driver's compartments may be disposed of and the bogies are interchangeable, which proved very advantageous. Tractive effort and power was increased by 10% by using a step transformer of higher performance, by changing the rotor winding of the motors and increasing their ventilation. The main technical data of the locomotive are tabulated. R.Neumann

621.335.4

6043 ELECTRIC MOTOR-COACH TRAINS 3000 V D.C. FOR CALCUTTA SUBURBAN TRAFFIC. H.D.Lascych.
Elekt. Bahnen, Vol. 31, No. 2, 34-41 (Feb., 1960). In German.

A detailed illustrated description of a three-part motor-coach train consisting of two control coaches at either end and a motor-coach containing all the electrical equipment in the middle. Of a total of 64 motor-coach trains 16 were built in Germany. The German and Swiss suppliers constructed the trains in such a manner that they were able to work in conjunction with trains built in England. Apart from this the special climatic conditions of India had to be taken into consideration. After a brief description of the coaches themselves the electrical equipment, traction motors, control units, roof equipment, drivers' compartments, h.v. chamber, starting resistors, auxiliaries consisting of a motor–generator set and battery, control-circuit couplings and conductors and their installation are discussed in greater detail. R.Neumann

621.34 : 621.313.333

6044 SOME DYNAMIC PROBLEMS OF ASYNCHRONOUS ELECTRICAL DRIVES. V.A.Shubenko.
Elektrichestvo, 1960, No. 1, 10-18 (Jan.). In Russian.

Transient torque conditions during starting, braking and reversing of induction motors are dealt with in detail. The problem is of particular importance in the case of automatic control of motors with low inertia. Certain methods of starting and speed control are suggested to limit torque under transient conditions to a safe value. This aspect of torque limitation is vital for preventing shaft failure in such applications as winding hoists etc. Oscillograms showing the relationship of torque, speed, current and voltage for various operating conditions are given and discussed. W.J.Grek

621.34

6045 LOW-INERTIA ELECTRICAL DRIVE FOR EXCAVATORS. M.I.Kraitsberg, D.A.Kaminskaya and V.P.Lomakin.
Elektrichestvo, 1960, No. 4, 26-30 (April). In Russian.

Shock loads and motor stoppages are outstanding characteristics of the drive to single-bucket excavators. The return of kinetic energy when the motor is forced to a stop is considerable, and imposes a strain on both structure and drive. Methods are examined of reducing

this effect by lowering the inertia of rotating parts of the system by such means as, for example, reducing the diameter of the driving motor armature in which is locked about 80% of the kinetic energy, lowering the motor speed and reducing or eliminating the reduction gearing of the drive. Details are given of such a modification imposed on a production model excavator and comparisons are drawn. The main disadvantages were found to be the greatly increased cost and weight of the motor, (130 tons as against 16 tons in the above-mentioned modification), lower efficiency (inputs 1100 kW/540 kW), and the difficulties experienced when the motor field is weakened. Against this must be set the obvious advantage of a reduction in the supply of kinetic energy in the ratio of 8.4 : 1. J.H.B.Gould

621.34 : 621.313.333

6046 SQUIRREL-CAGE AND SLIP-RING MOTORS FOR THE DRIVE OF BRIDGE CRANES AND MOBILE CRANES. H.R.Vogt.
Elektrotek. T., Vol. 73, No. 17, 283-8 (June 25, 1960). In Norwegian.

The characteristics of the two types of motor are discussed with special reference to the selection of sizes and ratings. The starting problem is considered and a formula is derived for the maximum ratio of bridge-crane speed to motor synchronous speed for wheel slipping on the rails not to occur. If due regard is paid to wheel adhesion, the squirrel-cage motor is satisfactory exept for the heaviest duties. For higher speeds, the slip-ring motor is more suitable, its main disadvantage being its relative inability to maintain a low speed independent of the load on the crane hook. G.N.J.Beck

621.34 : 621.316.718

REGULATION OF MULTI-MOTOR DRIVES. See Abstr. 6013

621.34

6047 3-PHASE DRIVES BY SQUIRREL-CAGE-MOTORS FOR MACHINES ON DECK. W.Harders.
Siemens Rev., Vol. 27, No. 1, 1-8 (Jan., 1960).

English translation of paper already abstracted as Abstr. 1528 of 1959.

CONDUCTORS . RESISTORS

(See also Semiconductor Materials)

621.315.57 : 539.2 : 537.3

6048 DYNAMIC CURRENT–VOLTAGE CHARACTERISTICS OF SILICON CARBIDE RESISTORS.
V.V.Pasynkov, G.F.Kholuyanov and L.K.Chirkin.
Fiz. tverdogo Tela, Vol. 2, No. 3, 434-7 (March, 1960). In Russian.

Deals with the dynamic I–V characteristics of low-voltage non-linear silicon carbide resistors at low current densities. The observed hysteresis of the I–V curves was due to charging and discharging of the self-capacitance of the resistors and it was not related to processes of micro-heating at contacts between silicon carbide grains. The self-capacitance of green and black varieties of silicon carbide was found to be independent of frequency in the 0.050-25 Mc/s region and of the magnitude of applied d.c. bias. A.Tybulewicz

621.315.57 : 621.316.825.2

6049 THERMISTORS, THEIR THEORY, MANUFACTURE AND APPLICATION. R.W.A.Scarr and R.A.Setterington.
Proc. Instn Elect. Engrs, Paper 3176 M, publ. Jan., 1960 (Vol. 107 B, 395-405, 405-9).

Republication, with discussion, of the paper already abstracted as Abstr. 147 of 1960.

INSULATING MATERIALS
DIELECTRICS

621.315.61 : 621.382

6050 A PROPOSED SPACE-CHARGE-LIMITED DIELECTRIC TRIODE. G.T.Wright.
J. Brit. Instn Radio Engrs, Vol. 20, No. 5, 337-55 (May, 1960).

Recent experiments have shown that large, controllable, space-charge-limited (s.c.l.) current can be obtained in insulating crystals of cadmium sulphide if these are grown sufficiently free from lattice defects and provided with a suitable cathode contact. A dielectric diode made in this way is analogous to the thermionic vacuum diode; in particular there is the possibility of adding a control electrode to form the dielectric triode which, together with the vacuum triode and the semi-conductor transistor will complete the basic trio of charge-control devices. This paper anticipates the construction of this triode and deduces the characteristics which it should possess. The basic equations of the triode are derived and it is shown that its d.c. characteristics should be very similar in form to those of the vacuum triode. Frequency characteristics are determined by electron trapping effects and equations are derived describing the response of the triode to time-varying signals. These equations are solved for the case of a sinusoidal signal voltage and the frequency dependence of mutual conductance and anode resistance calculated. It is shown that a triode relatively free from electron traps should have quite uniform characteristics up to frequencies at which transit times of the order of 1 mμsec become significant and should therefore be useful as a wide-band video amplifier. However, if the triode possesses a high density of shallow traps its parameters are markedly dependent on frequency. It is shown that in this case the mutual conductance should rise and the anode resistance should fall, possibly by very many times, as the operating frequency increases. The high frequency values should be maintained up to frequencies at which transit times of the order of 0.1 mμsec become significant; the device should thus be a useful v.h.f. amplifier. Because of its necessarily small size there are many technological problems involved in the construction of a practical triode. The development of the device is a worthwhile proposition, however, because it should possess a high input resistance, be relatively insensitive to temperature changes, and in its applications should be able to utilize the vast amount of circuit design accumulated for the vacuum triode.

621.315.61

6051 THE PRESENT STATE OF THEORIES CONCERNING THE INTRINSIC BREAKDOWN OF SOLIDS. V.Batka.
Prace Ustavu pro Elektrotech. CSAV, No. 9, 159-79 (1958). In Czech.

Breakdown phenomena depending solely on the physical state, microscopic structure and chemical composition of a dielectric are denoted as intrinsic. The author believes that the breakdown of a solid dielectric is an electronic process and starts this review with Froelich's theory of ionization by fast electrons. This is followed by a review of the following topics: (a) conductivity of solids; (b) theory of electrostatic ionization; (c) Wolkenstein's theory of thermal ionization; and (d) the theory of impulse ionization. 26 references. E.Erdélyi

621.315.613.1 : 621.313.1

INSULATION OF WINDINGS AND THE INCREASE OF PRODUCTION EFFICIENCY OF ELECTRICAL ROTATING MACHINES. See Abstr. 5967

621.315.614.6 : 539.2 : 537.2 : 545

6052 USE OF INFRARED SPECTROSCOPY IN THE STUDY OF CAPACITOR PAPER. M.S.Kozyreva and V.T.Renne.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 285-8 (1959). In Russian.

Shows that infrared spectrochemical analysis can be used to study chemical reactions occurring during heating of capacitor paper in air and also to distinguish between various types of paper. A.Tybulewicz

621.315.615

6053 ELECTRIC BREAKDOWN OF LIQUID SILICONES IN HIGH FREQUENCY FIELD. M.Ueda and M.Ito.
E.T.J. Japan, Vol. 5, No. 2, 56-60 (1959).

The breakdown voltage was measured between needle- and rod–plane electrodes, using liquids of viscosities 10-30,000 cS and over a frequency range 1-10 Mc/s. In the lower frequency range and with liquids of lower viscosity the b.d.v. was proportional to $(\text{freq})^{-1/2}$, and fell with increasing viscosity. This was expected on the basis of thermal breakdown. But at higher frequencies and viscosities, the b.d.v. was relatively independent of frequency and temperature. This effect is thought to be connected with ionic density and mobility. I.D.L.Ball

621.315.616 : 621.313.333

INDUCTION MOTORS INSULATED WITH "VETROTEX" AND SILICONES (CLASS H). See Abstr. 5980

621.315.616 : 621.315.2

6054 REINFORCED ZIEGLER POLYETHYLENE PIPES. K.Richard, G.Diedrich and E.Gaube.
Kunststoffe, Vol. 50, No. 7, 371-5 (July, 1960). In German.

Thermoplastic materials can be reinforced or strengthened by subjecting them to stretching at elevated temperatures. This characteristic has so far only been utilized in the field of synthetic fibres and film. A new process is described whereby Ziegler polyethylene pipes are bi-axially stretched and thereby strengthened Such pipes have twice the creep strength of ordinary pipes made of the same material and thus require to be only half the wall thickness.

621.315.616.96

6055 EFFECT OF HEAT AGEING ON THE ELECTRICAL AND MECHANICAL PROPERTIES OF VARNISHED TERYLENE FABRIC.
Rep. Brit. Elect. Res. Assoc., Rep. A/T153, 17pp. (1958).

The object of the work was to determine whether the high heat-resistance of Terylene fabric could be utilized with the fabric coated with varnish. The electrical and mechanical properties of alkyd- and silicone-varnished fabrics were examined as received and after ageing in air at 120° C, 155° C and 180° C for periods of 7, 14 and 28 days. The period of ageing for the tearing-strength test only was extended for successive periods of 112 and then 166 days. The tensile and tearing strengths, pH value and conductivity of aqueous extract, and developed acidity were determined on both unvarnished and varnished fabric. Electric strength tests at 20° C, 120° C and after immersion in distilled water at 25° C were made on varnished fabrics. A comparison was made of the deterioration in tensile strength with heat ageing of high- and medium-tenacity Terylene. As received the silicone-varnished fabric has been cured at 150° C only. In order to investigate the effect of a higher initial curing-temperature, the material was tested both as received and after a further cure at 200° C for 16 hours.

621.315.618.2 : 537.52

6056 HIGH-FREQUENCY BREAKDOWN OF AIR. D.Kelly and H.Margenau.
J. appl. Phys., Vol. 31, No. 9, 1617-20 (Sept., 1960).

Kinetic theory is applied to the problem of ionization breakdown of the air surrounding a high-speed vehicle. It is found that electrons are removed primarily by being swept out of the field of the moving aerial, and that in the interesting cases this action predominates over diffusion losses. Breakdown voltages are plotted against altitude for frequencies of 225 Mc/s, and 1 and 10 kMc/s. The theory may offer an explanation of some types of signal loss during missile flights.

621.315.618.2 : 537.52

6057 THE EFFECTS OF NUCLEAR RADIATION ON THE ELECTRICAL STRENGTH OF AIR. G.I.Duncan, J.C.Fraser and B.Valachovic.
Trans Amer. Inst. Elect. Engrs III, Vol. 79, 19-26 (1960) = Commun. and Electronics, No. 47 (March, 1960).

Tests with rod gaps spaced 0.0625 and 0.125 in. apart, show that between 100 and 160° C the breakdown voltage in air at 760, 76 and 7.6 mm Hg pressure is some 10 to 20% lower, when the gap is subjected to intense irradiation ($\sim 10^{12}$ γ-photons $cm^{-2} sec^{-1}$) than with unirradiated gaps. A similar reduction was found with a 0.25 in gap at 7.6 and 76 mm Hg pressure, but at 760 mm there was an inexplicable increase in b.d.v. J.H.Mason

621.315.618.2 : 537.52

6058 ELECTRICAL BREAKDOWN IN VACUUM BETWEEN GRAPHITE ELECTRODES. I.N.Slivkov.
Zh. tekh. Fiz.; Vol. 29, No. 12, 1473-4 (Dec., 1959), In Russian.

Measurements were made of the dependence of breakdown strength between graphite electrodes of different configurations on the electrode gap using pulse voltages (1.5-40 μsec). Bearings of the results on the mechanism of breakdown are discussed. Z.Krasucki

MEASURING METHODS
ELECTRICAL TESTING

621.317.2 : 621.316.57

6059 TEST METHODS AND EQUIPMENT FOR TESTING H.V. CIRCUIT-BREAKERS. M.Dvořák.
Elektrotech. Obzor, Vol. 49, No. 5, 244-50 (1960). In Czech.

Describes a new 35 MVA test-room for measuring the performance of circuit-breakers. Apparatus for mechanical adjustment of the breakers and for contact-pressure measurement is described. Measuring methods for dielectric strength, for arc energy and for pressure are discussed. N.Klein

621.317.2

6060 MEASUREMENTS IN THE TECHNIQUES OF ELECTRICAL MODELS. J.Hladik.
Prace Ustavu pro Elektrotech. CSAV, No. 9, 87-121 (1958). In Czech.

The solution of problems using models based on mathematical analogy demand great care with regard to measuring methods. The instrumentation to measure the following quantities is described: frequency; current; voltage. Direct reading phasemeters and appropriate circuits for indirect phase measurements are described in great detail. A special instrument, the vectorgraph, developed in the Electrotechnical Institute of the Czechosloval Academy of Sciences is described. This instruments measures directly the amplitude and phase of electrical quantities and records them simultaneously. E.Erdélyi

621.317.32

6061 POTENTIALS IN D.-C. CORONA FIELDS. G.W.Penney and R.E Matick.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 91-9 (1960) = Commun. and Electronics, No. 48 (May, 1960).

A probe method was devised for measuring potentials in d.c. corona fields which are uniform for a short distance in one direction. In unipolar corona, a probe supported by perfect insulators assumes a potential sufficiently above the space so that no more ions can reach the probe. For a cylindrical probe with its axis along an equipotential, this excess or "error potential" is proportional to the diameter of the cylinder. To minimize this error a fine wire is used as the probe. A frame is designed which both supports the wire and shields it from fields other than the field being measured. The fine wire is electrically connected to an electrostatic voltmeter, and the frame to a source of variable potential. A potential is measured by slowly increasing the potential of the frame and recording both frame and wire potential. Under proper conditions, the space potential is the point where wire and frame potentials are equal. Potentials were measured as a function of position in a corona field produced by a row of wires between parallel grounded planes. Potentials can be measured quite precisely so that gradients can be determined with reasonable accuracy; they can be measured close to the passive electrode which is the region of greatest importance in electrostatic precipitation. The method can also be used in abnormal corona where there are both positive and negative ions. A method is outlined for calculating the potential distribution when no space charge (corona current) is present in the geometry consisting of wires between parallel planes, and results are presented. Curves are presented which show how the potential and electric field distribution changes as the corona current is changed under various conditions.

621.317.33 : 621.313.322

6062 AGEING MEASUREMENTS ON HIGH-TENSION WINDINGS OF SYNCHRONOUS MACHINES. K.W.Edwin and W.H.Zwicknagl.
Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 7, 141-9 (April 1, 1960). In German.

A survey of periodic, non-destructive, d.c. and a.c. insulation tests on the stator windings of 25 alternators with outputs ranging from 6.72 to 125 MVA. While the available tests give information about some winding properties and their variation in service, they do not give a clear indication of the life-expectancy of the winding insulation. It is suggested that future investigations should concentrate on tests for detecting imminent insulation failure, possibly by using high d.c. or a.c. test voltages. A bibliography is included. H.Sterling

621.317.313 : 537.311.539.2

6063 MEASUREMENT OF THE SHEET RESISTIVITY OF A SQUARE WAFER WITH A SQUARE FOUR-POINT PROBE. F.Keywell and G.Dorosheski.
Rev. sci. Instrum., Vol. 31, No. 8, 833-7 (Aug., 1960).

The sheet resistivity of a thin sample of semiconductor may be measured by the placement of four probes on the surface of the sample. When current is passed between two of the probes, the potential difference between the other two probes is proportional to the current and the sheet resistivity of the sample. Sheet resistivity is then proportional to p.d./current, the proportionality or correction factor being dependent on the geometry of the sample and the probe. Calculations have been made for the correction factors in the case of a square probe array placed symmetrically on a square wafer. The correction factors for conversion of p.d./current to sheet resistivity are given for square dimensions, in units of probe spacing, over the range one to 50. The data include the special case d/s = 1 wherein the probe points are on the corners of the square.

621.317.332.1 : 621.372.5

THE DETERMINATION OF THE HYPERFREQUENCY CHARACTERISTIC IMPEDANCE OF A GIVEN QUADRIPOLE. See Abstr. 5599

621.317.333

6064 EVALUATION OF DISCHARGE PROCESSES IN HIGH-VOLTAGE EQUIPMENT. J.Koenig.
Elektrie, Vol. 14, No. 5, 153-6 (May, 1960). In German.

Reviews briefly the ways of observing high-frequency discharges in insulation. Consideration of their characteristics e.g. inception voltage, variation with time, enables one to discover the type and often the location of these discharges. (See also J.Koenig, Abstr. 2801 of 1960). I.D.L.Ball

621.317.333 : 621.327.534.15

VOLTAGE TEMPERATURE LIFE TESTING OF FLUORESCENT BALLAST INSULATION SYSTEMS. 6127

621.317.333.41 : 621.315.212

6065 THE AUTOMATIC OBSERVATION OF THE INSULATION OF CABLE INSTALLATIONS. A.Alt.
Tech. Mitt. P.T.T., Vol. 38, No. 3, 101-12 (1960). In French and German.

Automatic insulation "watching" apparatus has been developed which makes periodic insulation resistance measurements of the cable conductors and operates an alarm signal when a preset lower limit is reached. The real advantage of automatic control is the early indication of faults which cause the insulation resistance to fall slowly e.g. the slow ingress of moisture due to pinholes in the sheath. The construction of a particular automatic unit is described and circuit diagrams are given. R.J.Jordan

621.317.333.6 : 621.315.61

6066 FLASH-OVER CHARACTERISTICS ON THE CONDUCTIVE SURFACE.
N.Mita, T.Takemura, H.Kondo and K.Okubo.
Bull. Electrotech. Lab (Tokyo), Vol. 22, No. 4, 264-71 (April, 1958). In Japanese.

Deals with a.c. flashover phenomena of an impulse voltage on a conductive surface using an electrolyte etc. in the contaminated condition. The main results are presented. On the conductive surface, it is confirmed that the flashover voltage decreases in the case of an impulse voltage. This fact is useful for clarification of the flashover mechanism under the application of d.c. and a.c. voltages. It is concluded that the partial discharge, which develops with the nature of the partial glow or arc under impressed d.c. or a.c., will develop up to flashover through the same process as the impulse form at the last step. Considering the above conclusion, the d.c. and a.c. discharge currents are subject to the transient characteristics of the discharge circuit in the transition to flashover. Accordingly, it is necessary in the observation of flashover phenomena to examine the transient characteristics of the circuit consisting of L, C and R. It is generally desirable in the measurement of the flashover voltage on conductive surfaces to use a power source of large capacity, with small L and R.

621.317.34 : 537.7

6067 PHOTOELECTRIC METHOD FOR THE ANALYSIS OF FLUCTUATION RECORDS AND ITS APPLICATION TO ELECTRICAL NOISE. J.Scott.
Brit. J. appl. Phys., Vol. 11, No. 8, 377-81 (Aug., 1960).

Describes a method for obtaining the after-effect function for a stationary-fluctuation process from a record in the form of a graph or oscillogram. The method has been applied to the statistical analysis of some records of electric noise from various sources. Future possible developments of the method are indicated.

621.317.34 : 621.385.633.1

NOISE MEASUREMENTS ON AN M-TYPE BACKWARD-WAVE AMPLIFIER. See Abstr. 6307

621.317.341 : 621.372.51

6068 ERRORS DUE TO LOSSES IN MEASUREMENTS ON BALANCED ELEMENTS. M.Soldi.
Alta Frequenza, Vol. 29, No. 1, 30-58 (Feb., 1960). In Italian.

When a balun (balanced/unbalanced transformer) is used at metric wavelengths to measure balanced circuit impedances, errors arise which may be considerable through losses in the balun. As an example, the measurement of attenuation of a short length of twin line is discussed. Corrections for the measurements are obtained by the use of equivalent circuits. C.Fromberg

621.317.361

6069 DETERMINATION OF FREQUENCY FLUCTUATION WITH AN ERROR OF 10^{-9} TO 10^{-13} USING A DIGITAL MEASUREMENT OF BEAT-FREQUENCY. R.Mitterer.
Frequenz, Vol. 14, No. 5, 157-62 (May, 1960). In German.

A simple measurement procedure is described, in which the frequency to be measured (about 1 Mc/s) is compared with another frequency differing from it by about 1 c/s. The beat frequency is measured on a digital indicator with an error of about 10^{-5}. In this way the complete measurement, which can be performed within seconds, can be carried out with an error not exceeding about 10^{-11}. A.E.Karbowiak

621.317.373 : 621.375.13

6070 GAIN-PHASE MEASUREMENTS IN FEEDBACK AMPLIFIERS. M.Schreibman.
Electronics, Vol. 33, No. 20, 88-90 (May 13, 1960).

Methods of measuring accurately the gain and phase shift of amplifiers are considered. These are limited to amplifiers whose transfer function should be unity and consist of measuring the in-phase and quadrature components of the error signal when a loop is closed around the amplifier. This gives better accuracy than measuring small departures from unity in the output. A number of test circuits suitable for different conditions are shown. T.Horrocks

621.317.39 : 539.3

6071 MEASUREMENT OF CYCLIC STRAIN. T.M.Dowell and J.A.Mackinnon.
J. sci. Instrum., Vol. 37, No. 7, 255 (July, 1960).

Correction to circuit diagram in Abstr. 3410 of 1960).

621.317.39 : 621.396.933.2 : 531.71

6072 INTERNATIONAL SYMPOSIUM ON ELECTRONIC DISTANCE-MEASURING TECHNIQUES.
C.A.Whitten and E.Schmid [Editors].
J. geophys. Res., Vol. 65, No. 2, 385-528 (Feb., 1960).

This symposium was held in Washington, D.C., U.S.A. on May 5-12, 1959. Abstracts of some of the papers are published below. The remaining papers, which were condensed or abstracted because of space limitations or prior publication of part of the material, are as follows: Introductory remarks, A.Marussi (385-8); The Geodimeter system — a short discussion of its principal function and future development, E.Bergstrand (404-9); Use of the Geodimeter by the Coast and Geodetic Survey, P.D.Thomas (410); The model 3 Geodimeter for the extension of control for California Highways, J.D.Carter (411); The Tellurometer system — new applications to geodesy and hydrography, R.D.Smith (418-29); Report on electronic distance measurements in Australia, G.R.L.Rimington (430-5); Tellurometer measurements in the base extension network Munich, R.Sigl (436-40); Results of Tellurometer measurements in 1958, K.Gerke (441-3); Remarks concerning current use of the Tellurometer, G.Coets (444-8); Tellurometer trilateration in Arabia, H.Meier (449-52); Tellurometer observations on topographic mapping, J.L.Speert (453); Geodectic base lines, W.A.Heiskanen (454-6); Measurement of standard base line with the Väisälä light-interference comparator, T.Honkasalo (457-60); Canandian Shoran project, J.E.Ross (461); Hiran instrumental developments, P.W.Jordan (462-6); Evaluation of Hiran networks, S.D.Owen (467-71); Simultaneous adjustment of triangulation and trilateration — an investigation of Tellurometer lengths, L.A.Gale (472-7); Experimental results of field tests of the application of the Lorac phase comparison radio location system to distance measurement, B.W.Koeppel (478-89);

Microwave position-fixing system, H.R.Smyth (490-8); Electronic control systems used on hydrographic surveys, G.R.Fish (499-505); Some developments in Loran, W.O.Henry (506-13); The method and use of two-range Decca, G.W.LaCroix and D'A.H.Charles (514-24); Transistorized Raydist as used in geological surveys, C.L.Drake and W.C.Beckmann (525-8).

621.317.39 : 531.71

6073 ATMOSPHERIC LIMITATIONS ON ELECTRONIC DISTANCE-MEASURING EQUIPMENT.

M.C.Thompson, Jr. H.B.J.Janes and F.E.Freethey.
J. geophys. Res., Vol. 65, No. 2, 389-93 (Feb., 1960).

Measurements of path length over a base line of about 15.5 miles, using a radio link operating on approximately 9400 Mc/s, show that lack of knowledge of atmospheric turbulence is the limiting factor in electronic distance measurements. When corrections are applied for the radio refractive index measured at five points along the path the accuracy appears to be limited to several parts per million.
C.Hazard

621.317.39 : 531.71

6074 PHYSICAL PRINCIPLES OF THE ELECTRO-OPTICAL DETERMINATION OF DISTANCES. A.Karolus.

J. geophys. Res., Vol. 63, No. 2, 394-403 (Feb., 1960).

The principles of distance meters based on the methods of Fizeau and Karolus for the measurement of the velocity of light are discussed. The discussion is concerned primarily with the quantitative evaluation of the systematic errors in the methods of modulating light and of light and phase measurement. It is concluded that detailed study is necessary to develop a meter sufficiently accurately for geodetic applications.
C.Hazard

621.317.39 : 531.71

6075 AN ELECTRO-OPTICAL DEVICE FOR MEASURING DISTANCE. A.Bjerhammar.

J. geophys. Res., Vol. 65, No. 2, 412-17 (Feb., 1960).

A light beam is modulated at 4 Mc/s by passage through a piezo-electric quartz crystal between polarizers. The beam is transmitted over the distance to be measured and returned to a photocell. The output from the latter, together with a signal from the oscillator, is fed into a phase-sensitive superheterodyne circuit. The arrangement is suitable for distance from 50 m to 5 km. At 1 km the standard deviation of a single measurement was found to be ∓ 11 mm
G.F.Lothian

621.317.39

6076 AN AUTOMATIC CONTINUOUS DENIER RECORDER FOR SYNTHETIC TEXTILE YARNS.

C.D.Rutter, R.D.Wright, R.N.Aldrich-Smith and E.J.R.Hewitt.
Proc. Instn Elect. Engrs, Paper 3256 M, publ. Sept., 1960 (Vol. 107 B, 446-72).

Measuring the diameter of a fine textile filament by its electrical capacitance effect between the fixed plates of a capacitor presents the twin problems of the very small capacitance change to be measured and the high degree of stability to be maintained in the capacitor. The present instrument is insensitive to changes in the standing capacitance and achieves this by vibrating the yarn in and out of the gap. The capacitance between the two electrodes is therefore varying at the frequency of the vibrating yarn, and a variable capacitor is switched into circuit in phase with the yarn and used to balance this change is capacitance in a bridge circuit. The output from the bridge is amplified and used to drive a motor which balances the bridge by adjusting the variable capacitor. The movement of the motor also drives a pen recorder. The bridge circuit conveniently provides several measuring ranges and allows the measuring head to be one of several connected to the main instrument by long cables. Synthetic-fibre manufacture involves numerous identical production units in parallel. Monitoring and control gear is therefore fed from a multiplicity of transducers which must be matched, reliable and capable of simple routine test and replacement without upsetting their related circuits.

621.317.39 : 535.24

6077 DAYLIGHT FACTOR METER.
D.P.Turner.

J. sci. Instrum., Vol. 37, No. 9, 316-17 (Sept., 1960).

A brief survey and criticism of existing methods of measuring daylight factors is followed by a description of an improved daylight factor meter, in which the current outputs of two photoelectric cells are compared by a null-balance method. When one cell is exposed inside the building and the other outside, the ratio of the illuminations at the two positions is indicated directly on a calibrated scale by the balance position of the potentiometer. The circuit is so arranged that the load resistances of the cells are unchanged by changes in the balance position and, for a constant daylight factor, the balance position is not affected by changes in the average luminance of the sky. The instrument can be calibrated directly on an optical bench, either for use with the outside cell exposed to a full hemisphere of sky or for use with the outside cell so masked that light is only received from a part of the sky.

621.317.39

6078 A NEW PORTABLE DIAL TESTER.
J.L.Ingram.

A.T.E. J., Vol. 15, No. 4, 300-2 (Oct., 1959).

The dial tester provides facilities for testing impulse speed and ratio to an accuracy of the order of 1%. The operating principles are dealt with, followed by a description of the testing procedure. Particulars of the battery and a brief description of the general construction are also given.

621.317.39 : 621.396.963

ELECTRICAL METHOD OF EYE-MOVEMENT RECORDING. See Abstr. 6438

621.317.39 : 621.389

THE CONTINUOUS AUTOMATIC MEASUREMENT OF BLOOD PRESSURE USING A CONTROL SYSTEM. See Abstr. 5726

621.317.39 : 621.389

RADIO-SONDES FOR USE IN THE ALIMENTARY CANAL. See Abstr. 5730

621.317.44 : 538

6079 A STUDY OF MAGNETIC FOCUSING SYSTEMS.
M.Arnaud and O.Cahen.

Rev. tech. C.F.T.H., No. 32, 41-58 (Feb., 1960). In French.

The first part describes a "recording turbine magnetometer", in which compressed air drives a rotating copper vane, the magnetically induced current in which induces current in a fixed coil connected to an amplifier and recorder. Magnetometer probes of 6 and 9 mm size, with vane speeds of 400 to 500 rev/sec, measure fields from 0.5 to 3000 Oe with attainable accuracy of 0.5%. The second part deals with, and gives examples of, use of the magnetometer in association with an electrolytic tank, for designing and correcting magnetic circuits for the production of fields such as those used in the focusing of O-tubes.
B.Meltzer

INSTRUMENTS
MEASURING APPARATUS

621.317.7 : 621.365.4

6080 DESIGN OF HEATING UNITS FOR INSTRUMENTS.
A.O.Sall'.

Priborostroenie, 1959, No. 8. In Russian. English translation in: Instrum. Constr., 1959, No. 8, 19-20 (Aug.).

Simple equations are given for calculating the surface temperatures of a heater and a surrounding box on the assumptions that the transfer of heat is by conduction only, and that the two surfaces are concentric spheres, coaxial cylinders or parallel flat plates. It is shown that the equations can be used for approximate solutions of the temperature gradient between surfaces of more complex shape, and an example is given of the evaluation of the sensitivity of a bolometer used for infrared gas analysis.
C.F.Pizzey

621.317.714 : 537.7

6081 ERROR OF RECTIFIER-TYPE MILLIAMMETERS IN LOW-RESISTANCE CIRCUITS.

J.Wilbur-Ham and W.E.K.Gibbs.
J. sci. Instrum., Vol. 37, No. 9, 313-15 (Sept., 1960).

Although a bridge-rectifier meter indicates r.m.s. current when the current is sinusoidal, a sinusoidal voltage produces a non-sinusoidal current, and hence an error in the indication, because the resistance of a copper-oxide rectifier is non-linear, varying as the -0.7 power of the current. Series resistance tends to swamp the non-linearity, and the error, calculated by arithmetical integration, is shown on a nomogram relating error, series resistance and meter indication. Experiment confirms the results.

621.317.715

6082 GALVANOMETER DEFLECTION MICROMETER. O.S.Lutes.
Rev. sci. Instrum., Vol. 31, No. 7, 780 (July, 1960).

The device is used with a reflecting galvanometer. A vertical slit, 1 mm wide, is placed in front of the lamp, and the galvanometer mirror projects an image of the slit on to a second slit, also 1 mm wide, in the side of a box 1 m distant from the mirror. The box contains a photocell (type 919) which is connected to a 90 V battery and a secondary galvanometer. The box is mounted on guides so that it can move across the beam, and its movement is controlled and measured by rotating the thimble of a micrometer. The primary galvanometer zero is chosen at any convenient micrometer setting for which part of the beam is incident on the photocell. Deflection of the primary galvanometer is measured by adjusting the micrometer to restore the initial reading of the secondary galvanometer, the magnitude of the deflection being the difference in micrometer readings. The amplification is linear, since the same area of photosensitive surface, and the same secondary galvanometer reading, are used in both the undeflected and deflected positions. It is stated that the sensitivity is such that the position of the image can be determined with an accuracy of better than ±0.005 mm. C.F.Pizzey

621.317.722.4

6083 VOLTAGE DIVIDERS FOR THE MEASUREMENT OF SURGE VOLTAGES. B.Grüner-Nielsen.
Ingeniøren B, Vol. 69, No. 11, 351-9 (June 1, 1960). In Danish.

Methods of testing voltage dividers are discussed. The most accurate method is to apply an impulse of the type measured but at a much lower voltage. The pulse is measured with another divider having insignificant error at the low voltage. Sources of error for the four main types of voltage divider (capacitive, mixed, pure ohmic and capacitively screened ohmic) are examined theoretically. Response curves for a rectangular waveform are determined for the pure ohmic divider and two types of capacitively screened ohmic divider. All three types showed agreement between the measurement error determined from the response to the rectangular wave and the error observed in direct test. All three can be used for measurement of standard 1/50 surge voltages. The simple ohmic divider is, moreover, less affected by earthed objects in its vicinity than generally assumed. The best measurement results are obtained with an ohmic divider with h.v. resistance wound with small self-inductance and a small screen at the top to compensate for the capacitance-to-earth of the resistance, and a suitable damping resistor arranged in the measurement circuit. G.N.J.Beck

621.317.725 : 621.314.63

6084 PORTABLE DIRECT-READING VOLTMETER FOR ARC-DROP MEASUREMENT. K.Müller-Lübeck.
Elektrotech. Z. (E.T.Z.) A, Vol. 81, No. 11, 397-400 (May 23, 1960). In German.

Describes the working principles of an indicating instrument developed for the simple measurement of arc-drop voltage in controlled and uncontrolled convertors and suitable for dynamic testing of the forward voltage drop of semiconductor rectifiers. The indication is made insensitive to the negative half-cycle and to high positive potentials when ignition is retarded. The device provides facilities for curve tracing. Accuracy is ±2.5%. P.Szekely

621.317.725

6085 THE STEP-BY-STEP POTENTIOMETER AS A DIGITIZER. G.P.Tonkin.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 523-8 (July, 1960).

A digital potentiometer-type millivolt recorder is described in which resistances are successively paralleled by relays to modify the current in a standard resistor and hence the p.d. across it. This process progresses automatically until balance is detected, when the relay state is transferred into a store. Three separate digitizing channels are employed in series-parallel to give a speed of 25 characters/sec at a tape punch, or 10 characters/sec with a simultaneous typed record. Alternatively, single chosen channels can be brought out on a visual figure display. The equipment can be provided with inputs as multiples of 72 channels with a maximum sensitivity corresponding to 15 mV full scale at 200 ohms source impedance. The resolution is 1 part in 1000 of full scale. The instrument is of bench-top size and is suitable for measurements in multiple installations of resistance strain gauges, thermocouples and other transducers of similar output.

621.317.725

6086 A WIDE-RANGE FULLY-AUTOMATIC DIGITAL VOLTMETER. J.A.Irvine and D.A.Pucknell.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 536-40 (July, 1960).

The requirements which led to the development of a digital voltmeter are discussed and various possible systems are considered. The reasons for choosing the present system are given. The potentiometer network and reference supply, the transistorized comparator and difference amplifier, and the selector switch control circuitry are described. The voltmeter has an input impedance of 10 MΩ and automatic polarity and range selection. It reads to 3 digit with an accuracy of ±1 digit over the range 10 mV to 1000 V.

621.317.725

6087 AN ALL-ELECTRONIC FOUR-DIGIT DIGITAL VOLTMETER. H.Fuchs and D.Wheable.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 541-7 (July, 1960).

Describes a four-digit voltmeter and deals with the mode of operation and a number of problems that have been solved. A feature of the instrument is the automatic range change circuit which operates the input attenuator and minimizes errors arising from reverse grid current flowing in this attenuator. The fundamental accuracy of the instrument depends on the method of voltage comparison and particular emphasis is placed upon drift correcting these comparators using the principle of time-sharing. The generation of linear ramps is described and results of laboratory measurements verifying theoretical predictions are given. The high speed decimal counter using the trochotron tube is described and shown to be ideally suitable for operating with neon-type number tubes. All the likely errors are discussed.

621.317.73

6088 VERTICAL TYPE COAXIAL SLOTTED LINE FOR IMPEDANCE MEASUREMENTS IN THE REGION OF 30 TO 300 MEGACYCLES. T.Iwase and S.Omori.
Bull. Electrotech. Lab. (Tokyo), Vol. 22, No. 4, 299-305 (April, 1958). In Japanese.

The slotted line is a vertically supported coaxial line 6 m long, having a surge impedance of 50.0 Ω. Details of design and construction are discussed. Measured mechanical inaccuracy of the resulting electrical error, the detector system, and some improvements further introduced are briefly given. Its accuracy is estimated to be less than 2%.

621.317.733

6089 A VECTOR NULL INDICATOR FOR A.C. BRIDGES. D.L.H.Gibbings.
Austral. J. appl. Sci., Vol. 11, No. 2, 244-9 (June, 1960).

A null indicator for use with audio-frequency bridges is described in which the out-of-balance voltage is represented as a vector by the position of the spot on a cathode-ray tube.

621.317.733

6090 AUTO-BALANCING TYPE IMPEDANCE MEASURING APPARATUS. K.Tsurui.
Bull. Electrotech. Lab. (Tokyo), Vol. 22, No. 4, 306-14 (April, 1958). In Japanese.

An auto-balancing-type impedance measuring apparatus based on the principle of a Geyger a.c. potentiometer using a phase-shifting transformer, balancing motor and amplifier is described. The apparatus has been converted into a recording type. Results of tests made on various electrical meters by means of the apparatus are given.

621.317.733

6091 A.C. BRIDGES WITH INDUCTIVE RATIO ARMS. COMPENSATION FOR LEAKAGE REACTANCE EFFECTS. F.Butler.
Electronic Technol., Vol. 37, No. 8, 303-11 (Aug., 1960).

Impedance bridges using transformer-connected ratio arms are subject to errors caused by imperfect magnetic coupling between the ratio arms. In principle, high precision can be attained by proper attention to the design of the transformers, by employing core materials of very high permeability and, where possible, using bifilar or other close-coupled windings. It is shown that errors due to the use of transformers of normal design and construction may be greatly reduced by a procedure involving a preliminary balance followed by a second balance with the unknown impedance short-circuited. Alternatively a calculable correction may be applied to the balance observations.

621.317.74 : 621.391.822

6092 A NEW MEASURING SET FOR MESSAGE CIRCUIT NOISE. W.T.Cochran and D.A.Lewinski.

Bell Syst. tech. J., Vol. 39, No. 4, 911-31 (July, 1960).

A new message circuit noise measuring set is described. The instrument is an easily portable, visual-indicating and direct-reading device with which rapid and accurate noise measurements may be made. The set is fully transistorized and battery powered, small in size and light in weight. It can be used for bridging, terminating and noise-to-ground measurements with a variety of plug-in weighting networks, one of which is the new C-message weighting designed for the 500-type telephone set. The sensitivity of the set is such that it can detect −90 dBm. This value is chosen as the new reference for measurement and is defined as "zero dBrn".

621.317.741

6093 A DELAY DISTORTION SIMULATION SET. F.C.Dunbar.

Trans Amer. Inst. Elect. Engrs I, Vol. 79, 183-5 (1960) = Commun. and Electronics, No. 48 (May, 1960).

The delay simulator is a test instrument which produces delay as a function of frequency in the range 300-3300 c/s. Its primary function is to simulate the delay distortion of Bell System transmission facilities, including open-wire, loaded-cable, and carrier systems. This is accomplished by combining four variable delay characteristics thus obtainable may be useful for testing actual data transmission systems or any other waveforms.

621.317.742

6094 A SIMPLE PHASE-METER FOR LABORATORY USE. B.Chatterjee.

Indian J. Phys., Vol. 33, No. 3, 111-16 (March, 1959).

The construction of this equipment is very simple and the accuracy of measurement is much better than that available with an oscilloscope. It needs no calibration and can be used over a wide frequency range.

621.317.75 : 539.1.07

6095 LINEARIZING THE BOTTOM CHANNELS OF THE 256-CHANNEL PULSE HEIGHT ANALYSER. R.M.Rodrigues, H.I.West, Jr and J.J.Ronchetto, Jr.

Rev. sci. Instrum., Vol. 31, No. 7, 790-1 (July, 1960).

The modifications made to a 256 channel analyser to improve the linearity of the bottom channels are described. The disadvantage of the circuit used is that it inevitably increases the analyser dead time (~9 μsec) but this is offset by the ability to use the bottom channels.

C.F.Barnaby

621.317.753

6096 CORRECTION OF THE FREQUENCY CHARACTERISTIC OF ELECTROMAGNETIC OSCILLOGRAPHS. A.Scabrosi.

Elettrotecnica, Vol. 47, No. 2, 58-65 (Feb. 10, 1960). In Italian.

The effects of damping and temperature variation on the response of an electromagnetic oscillograph are reviewed. It is shown that the useful frequency range can be extended by the addition of a transistor amplifier and simple filter circuit. Experimental results are presented in confirmation. A.E.I.Research Laboratory

621.317.757

6097 FOR TRANSIENT STUDIES SPECTRUM ANALYZER SUPPLIES PERMANENT RECORD. R.J.Farber and A.Proudfit.

Electronic Industr., Vol. 19, No. 1, 69-72 (Jan., 1960).

A general description is given of a spectrum analyser in which the simultaneous operation of many filters and read-out devices eliminates the scanning or commutation methods employed in other equipment. The spectrum coverage may be linear or logarithmic depending on the tuning of the individual filter circuits. The read-out device consists of a 450 track, electrolytically marked, 15 in. wide paper strip which may be driven at speeds ranging from 1.5 in/min to 6 in/sec. Transistors are employed and some interesting details regarding the paper-marking circuits are discussed. Two speech-analysis records are shown for illustration and possible applications of the equipment to other problems are considered.

H.L.Nattrass

621.317.763

6098 HIGH Q WAVEMETER DESIGN. E.F.Goodenough.

Marconi Rev., Vol. 23, 85-98 (2nd Qtr, 1960).

The design of a wavemeter having a frequency discrimination better than 1/35 000 Mc/s at Q-band is given.

621.317.78 : 621.316.57

6099 APPARATUS FOR MEASURING THE ARC ENERGY DURING THE OPENING OF CIRCUIT-BREAKERS. E.Stepanek and S.Wagner.

Elektrie, Vol. 14, No. 5, 161-2 (May, 1960). In German.

The apparatus determines the instantaneous power and measures the integral of the power over the arcing period, the result being indicated directly on a suitably calibrated valve voltmeter. Two voltages, V_1 and V_2 (max. 0.3 V), are derived from a resistance network connected to the circuit-breaker test circuit. It is shown that the instantaneous power in the arc is proportional to $V_1^2 - V_2^2$. Voltage V_1 is applied to a ring modulator which is followed by a squaring stage, an amplifier and a demodulator. Voltage V_2 is applied to a similar arrangement. An adjustment is provided for equalizing the amplification of the two channels. The carrier frequency input for the two ring modulators is supplied by a 2 kc/s valve generator. The output circuits of the two demodulators are connected so that their output voltages are in opposition, and the difference voltage is applied to an RC integrator with a time constant of 20-30 sec. The max. voltage across the capacitor of the integrator is measured by the valve voltmeter. The apparatus is calibrated by connecting a capacitor in place of the circuit breaker test circuit, and charging it to the appropriate voltage.

C.F.Pizzey

621.317.784

6100 RESISTIVE-FILM MILLIWATTMETERS FOR THE FREQUENCY BANDS 8.2-12.4 Gc/s, 12.4-18 Gc/s AND 26.5-40 Gc/s. I.Lemco and B.Rogal.

Proc. Instn Elect. Engrs, Paper 3298 E, publ. Sept., 1960 (Vol. 107B, 427-30).

A commercially developed version of a wideband microwave milliwattmeter for the frequency band 8.2-12.4 Gc/s, based on Lane's principle of mounting a narrow resistive strip in the transverse plane of a waveguide, is described. The instrument gives power measurements in the range 1-100 mW with an accuracy within ±2%. Effects of temperature are discussed, and a robust version of the milliwattmeter is mentioned. Two models designed on the same principle for the frequency bands 12.4-18 Gc/s and 26.5-40 Gc/s are also described. Comparison of these with other power-measuring instruments indicates that the resistive strip mounts are of high accuracy at these frequencies. This is obtained by the simplicity of design of these mounts resulting in lower power losses.

621.317.789

6101 A MICROWAVE SMALL POWER STANDARD. T.Tamaru, K.Sakurai and T.Maruyama.

Bull. Electrotech. Lab. (Tokyo), Vol. 22, No. 4, 251-64 (April, 1958). In Japanese.

Describes an experimental microwave microcalorimeter for the 7 kMc/s band. The calibration method of bolometer mounts is described. The calorimeter is similar to a d.c. calibrated, aneroid microcalorimeter of the twin type, and its calorimetric body is a thin walled barretter mount. By using this barretter mount, the effective efficiency of which is determined by electric and thermal measurements, the effective efficiencies of some other bolometer mounts are accurately determined using a magic-T as a power divider and an impedance comparator. Analysis of the magic-T which is used as a power divider and an impedance comparator is also included.

MAGNETIC DEVICES AND MATERIALS

621.318 : 681.142

6102 A MAGNETIC DRUM WITH A ONE MEGABIT STORAGE. R.R.Schaffer.

Electronic Industr., Vol. 19, No, 3, 114-17 (March, 1960).

Discusses the read/write heads and associated circuits used in the process of increasing the storage capacity of a magnetic drum from 125 000 bits to 10^6 bits. The original drum employed 50 bits/in. and 20 tracks/in. operating at 125 kc/s whilst the modified head and circuits permit 200 bits/in. and 40 tracks/in. at 500 kc/s.

G.H.Stearman

621.318.1

6103 MAGNETIC FIELDS OF SQUARE-LOOP THIN FILMS OF OBLATE SPHEROIDAL GEOMETRY. H.Chang and A.G.Milnes.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 458-64 (Dec., 1959).

Thin films of Ni–Fe alloy may be prepared to be anisotropic and exhibit square-loop M–H characteristics. In films that are single-domained with flux changes involving only rotation of intrinsic magnetization controlled by cross-magnetization fields, very fast switching action can be obtained for storage and logic functions. Problems of coupling to the flux changes and interaction in an array of such films require study of the magnetic-field distribution. In the treatment given, a characteristic -domain, thin film is represented by a very flat oblate spheroid. The field distribution outside the spheroid is found by assuming that the magnetic properties are characterized by an intrinsic magnetization M constant in magnitude, but varies in direction depending on field and energy considerations. Calculation of the field distribution is given for a typical film with diameter to thickness ratio of 10^5. From the regions over which field changes are most significant, conclusions are drawn as to the proper size of sensing loops and spacing to avoid interaction during switching in film arrays.

621.318.1

6104 ELECTRODEPOSITED TWISTOR AND BIT WIRE COMPONENTS. S.J.Schwartz and J.S.Sallo.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 465-9 (Dec., 1959).

Electrodeposition of ferromagnetic materials on wire is a suitable way of producing magnetic storage elements. One form of this element, when placed under suitable torsional strain (i.e. as a twistor), has magnetic properties suitable for memory application. Through research into the electrodeposition process, a new device has been developed which requires no external stressing. This device has been designated as the "bit wire". The materials possess the desirable temperature stability usually associated with ferromagnetic metals and exhibit a high signal-to-noise ratio. Both linear selection and coincident current memory arrays have been constructed with bit wire and plated twistors. The switching characteristics and drive requirements are similar for both materials. The significant difference lies in the fabricating technique, since the bit wire requires no stressing. Both devices are packaged, since undesired strains can change their properties. This problem has been minimized by plating the bit wire material on semirigid wire or tubing. The tubular structure offers other advantages, since additional sense, drive, or inhibit wiring may be threaded through the tube.

621.318.1

6105 DIODE-STEERED MAGNETIC-CORE MEMORY. A.Melmed and R.Shevlin.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 474-8 (Dec., 1959).

Economy is obtained by means of a two-coordinate selection system using diffused junction rectifiers as steering diodes. By taking advantage of the relatively slow recovery time of these rectifiers, automatic rewrite selection is obtained in a similar sense to that provided by a biased switch core. The familiar "inhibit" line is eliminated, reducing the memory array to a two-wire configuration. The customary core array geometry is rearranged to facilitate winding the digit wire as a balanced twisted-pair transmission line so as to eliminate the effect of post-write disturb.

621.318.1 : 538

6106 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON SOME ASPECTS OF MAGNETISM, SHEFFIELD, SEPTEMBER 1959. R.S.Trebble and D.E.G.Williams.
Brit. J. appl. Phys., Vol. 11, No. 8, 307-13 (Aug., 1960).

The following subjects were discussed at this conference which was held at Sheffield University by the Institute of Physics: (1) the behaviour of ferrites and some alloys; (2) domain effects and thin films; (3) domains; (4) neutron diffraction; (5) permanent magnet materials.

621.318.1

6107 ON EXPRESSIONS OF MAGNETIC HYSTERESIS CHARACTERISTICS. S.Ohteru.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1809-15 (1960) = Pwr Apparatus Syst., No. 46 (Feb., 1960).

An equivalent electric circuit is presented which simulates the phenomenon of magnetic hysteresis. The analogue variables are current and temperature, the circuit consisting of an e.m.f. feeding an infinite number of parallel branches each containing a resistance in series with a bimetal switch loaded with a permanent magnet so as to produce different closing and opening temperatures x_0 and x_f. By a suitable choice of the distribution functions for x_0 and x_f (which are different for each switch) it is shown that the function $i = f(x)$ can be made to represent the familiar B–H curve. A mathematical analysis concentrates on three particular cases: (1) $x_0 - x_f = \tau$ or a constant width loop: (2) $x_0 - x_f = \tau/2$ useful in studying the influence of core shape: and (3) x_0 and x_f as independent distribution functions. More accurate approximation to the magnetization characteristics can be obtained by the addition of a second group of resistive branches operated by reversible bimetal switches (without magnets). The analogy does not take into account either eddy currents or magnetic after-effects. Eight references.

Z.A.A.Krajewski

621.318.132

6108 THIN FERROMAGNETIC FILMS. A.C.Moore.
I.R.E. Trans Compon. Parts, Vol. CP-7, No. 1, 3-14 (March, 1960).

An account of work at the Royal Radar Establishment on the preparation and properties of thin ferromagnetic films. The work provides the prospect of a computer store in which 10^6 bits would occupy less than 18-in^3 and which would possess a switching time faster than 20 mμsec. The store would be cheap and easily constructed.

621.318.132 : 538.2 : 539.2

6109 WALKER MODES IN LARGE FERRITE SAMPLES. B.A.Auld.
J. appl. Phys., Vol. 31, No. 9, 1642-7 (Sept., 1960).

The modes of resonance for a ferrite strip and a ferrite post resonator between conducting planes are found by taking appropriate combinations of uniform plane wave solutions. It is shown that magnetostatic resonances (Walker modes) may exist even when the resonator dimensions are arbitrarily large, provided the mode indices satisfy certain restrictions.

621.318.23

6110 IMPROVEMENT OF ATTRACTION CHARACTERISTICS OF A.C. ELECTROMAGNETS. P.M.Vaisburd.
Elektrichestvo, 1960, No. 3, 82-3 (March). In Russian.

It is often required to alter the attractive-force characteristics of an electromagnetic without modifying its construction. Fundamentally, increase of the attractive force can be achieved either by increase of the supply voltage or by reduction of the effective impedance of the winding. Three simple methods of improvement are discussed; (1) increase of the supply voltage; (2) rectification of the supply current; (3) series or parallel connection of a capacitor for ferroresonance. In each case, due consideration must be given to the heating of the winding and a method of connection chosen, which will limit current in the winding to a permissible value.

W.J.Grek

621.318.381 : 538.1

6111 TEMPERATURE-CONTROLLED PERMANENT MAGNET FOR HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE. B.A.Evans and R.E.Richards.
J. sci. Instrum., Vol. 37, No. 9, 353-5 (Sept., 1960).

The design and construction of a large temperature-controlled permanent magnet is described and the considerations given towards obtaining a high degree of field uniformity. Using current shims and a spinning sample, a resolving power and stability of a few parts in 10^8 may be obtained at any time and, with care, 1 part in 10^9 can be achieved.

INDUCTORS . REACTORS
RELAYS

621.318.435

6112 FIRING ANGLE IN SERIES-CONNECTED SATURABLE REACTOR. I.Bady.
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 790 (April, 1960).

A brief note demonstrating theoretically that in a series-connected saturable reactor, with free even harmonics, the firing angle is independent of the control voltage when this voltage does not exceed a critical value. The value of the limit is derived in terms of the circuit parameters.

A.K.Podkolinski

621.318.562.5 : 539.1.07

6113 TRANSISTOR OPERATION OF ELECTROMECHANICAL REGISTERS. J.C.Barton.
J. sci. Instrum., Vol. 37, No. 8, 303 (Aug., 1960).

G.P.O.-type registers and other devices can be stably operated

in a blocking oscillator circuit with one transistor and extremely small current drain when not actually counting. A.Sczaniecki

621.318.562.7

6114 TIME MULTIPLICATION WITH A TIME RELAY. F.Lund.

Elektrotek. T., Vol. 73, No. 18, 297-300 (July 5, 1960). In Norwegian.

By the use of a time relay in conjunction with ordinary relays, a combination can be made with considerably increased delay time. With the circuit connections shown, 40 ordinary relays can be combined with one time relay having 5 sec delay to produce a composite relay with a $4\frac{1}{2}$ hrs. delay; with 80 ordinary relays, the delay can be increased from 5 sec to $1\frac{1}{2}$ years. The circuit algebra is explained in detail, and it is shown how maximum delay can be obtained with minimum additional relays. G.N.J.Beck

621.318.57

6115 HIGH CURRENT ELECTRONIC INTERRUPTER FOR THE STUDY OF ELECTRODE PROCESSES. W.E.Richeson and M.Eisenberg.

J. Electrochem. Soc., Vol. 107, No. 7, 642-7 (July, 1960).

The design of a fast, high current interrupter capable of handling up to 5A is presented. Through small modifications even larger currents can be handled. The electronic interrupter is exceptionally versatile, has a short rise time, a variable output current, and a switching rate from 500 c/s to any longer period desired. Interruption periods as short as 1.6 μs were found to be quite practical. The applications of the interrupter in the field of electrochemical kinetics are illustrated through experimental work. Potential–time traces for anodic dissolution of titanium were studied.

621.318.57 : 621.374.32

CONTACTLESS RELAY WITH TRANSISTORS. See Abstr. 5642

ELECTROSTATICS . CAPACITORS

621.319.4

6116 A NEW MINIATURE CAPACITOR MADE OF LACQUERED METAL FOIL. V.T.Renne.

Elektrichestvo, 1960, No. 4, 77-80 (April). In Russian.

Reviews German, British and Italian work on lacquered metal-foil capacitors (German "ML" and Italian "Metalac" types). See, for example, Abstr. 844, 6464 of 1959. A.Tybulewicz

621.319.4

6117 PROLONGING THE LIFE OF A.C. CAPACITORS. P.Hochhäusler.

Elektrotech. Z. (E.T.Z.)B, Vol. 12, No. 12, 292-4 (June 13, 1960). In German.

The factors limiting the life of impregnated-paper capacitors on a.c. duty are discussed. It is argued that as long as the ionization inception voltage is not exceeded, and provided the heat due to dielectric losses is conducted away, the capacitors will have very long lives. Both oil and chlorinated diphenyl impregnants are considered, the latter being preferred. K.W.Plessner

621.319.4

6118 NEW IMPREGNATION FOR PAPER CAPACITORS. L.Borsody.

I.R.E. Trans Compon. Parts, Vol. CP-7, No. 1, 15-25 (March, 1960).

The possibility was examined of improving paper capacitors by the applications of new types of impregnants. The tests proved that the paper capacitors impregnated with the various new impregnants can be improved to such an extent that they are as good as plastic-film types in stability, heat resistance, and temperature coefficient. In addition, paper capacitors are far smaller than plastic film dielectric capacitors.

621.319.4

6119 OIL-IMPREGNATED PAPER CAPACITORS. SOME FACTORS AFFECTING THE DISCHARGE INCEPTION STRESS. J.H.Mason.

Rep. Brit. Elect. Res. Assoc., Rep. L/T373, 9 pp. (1958).

The discharge inception voltage in oil-impregnated paper capacitors may be seriously over-estimated if tests are made using an insufficiently sensitive discharge detector, or if the applied voltage is increased too rapidly. Proof tests to eliminate capacitors with low discharge-inception values should be made at a voltage level determined by the sensitivity of the discharge detector (preferably sensitive to discharges smaller than 10 pC in the capacitors under test) and by the time available for test. If for rapidity the full proof voltage is maintained for about one second only, the voltage should be some 25-30% greater than for tests with the proof voltage maintained for 15 sec. Tests show also that: (a) the a.c. discharge-inception stress in oil-impregnated paper capacitors decreases with increase in the thickness of the individual papers, and with the total paper thickness; (b) the superposition of direct voltage causes a comparatively small reduction in the a.c. discharge-inception stress; e.g. direct stress of 80 V/micron reduces the a.c. inception stress in four different makes of capacitor from some 35 to 40 V(peak)/micron to between 25 and 30 V(peak)/micron.

621.319.42

6120 THEORY AND ORIGINS OF THE OSCILLATIONS IN CAPACITORS DURING IMPULSE DISCHARGES AND HIGH-FREQUENCY CURRENTS. H.Stephanides.

Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 11, 253-61 (June 1, 1960). In German.

An impregnated-paper capacitor-element is considered which is of the flattened type, with the electrode foils extended at each end of the element, contact being made over the whole of each end face. The current distribution over the thickness of the element is calculated and it is shown that this becomes non-uniform at high rates of change of the current. Expressions for the total current as a function of time are derived for the cases of the capacitor discharging through a short-circuit or through an external inductance or for an imposed sinusoidal voltage. K.W.Plessner

621.319.44

6121 IMPULSE CAPACITORS FOR NUCLEAR FUSION EXPERIMENTS. H.Stephanides.

Schweiz. tech. Z. (S.T.Z.), Vol. 57, No. 13, 241-4 (March 31, 1960). In German.

The design of large capacitors for energy storage and rapid discharge duty is considered. Only paper capacitors are mentioned, having either solid-foil or thin metallized electrodes. The best arrangements of the winding elements in order to minimize self-inductance in the capacitor are described and the importance of keeping the inductance of each parallel path the same to avoid internal circulating currents is pointed out. K.W.Plessner

621.319.5 : 621.359.4

6122 A THEORY FOR SPACE-CHARGE-LIMITED CURRENTS WITH APPLICATION TO ELECTRICAL PRECIPITATION. P.Cooperman.

Trans Amer. Inst. Elect. Engrs III, Vol. 79, 47-50 (1960) = Commun. and Electronics, No. 47 (March, 1960).

An iterative theoretical calculation, taking account of the space charge due to corona current, is used to determine the potential function for two different electrode geometries used in electrostatic precipitators. Corona current–voltage relationships are also obtained. Townsend's classical equation for the current–voltage characteristic for coaxial cylinders, which corresponds to pipe-type precipitators, is verified. The equations derived for equally spaced, coplanar conductors symmetrically between two infinite plane parallel electrodes are taken to represent operating conditions in a duct-type precipitator. A number of conclusions concerning the physical dimensions of duct-type precipitators are drawn from these equations. T.R.Foord

621.319.53

6123 THE GENERATION OF HIGH-VOLTAGE RECTANGULAR PULSES AND THE PROTECTION OF TEST SAMPLES AND ELECTRODES. K.H.Stark and J.B.Higham.

Rep. Brit. Elect. Res. Assoc., Rep. E/T70, 5 pp. (1958).

Circuits are described for producing "rectangular" pulse voltages of the order of 100 kV, decaying no more than 1% in times up to 1 ms. The instant of application to a test sample is predetermined in relation to the occurrence of another event with an error of less than ±0.1 μs, and the duration of a pulse, from 0.5 to 10 μs for example, is predetermined with similar accuracy. The circuits also enable a breakdown current through a test sample to be terminated in less than 1 μs, thus limiting damage to the sample and its electrodes.

LAMPS . ILLUMINATION

621.326 : 621.389

6124 MICROSCOPIC FILAMENT LAMP. W.Hennig.

Elektron. Rdsch., Vol. 14, No. 3, 97 (March, 1960). In German.

Describes a tungsten lamp of tubular form, 2.5 mm long and 0.6 mm in diameter, with a coiled filament of 25 μ diameter, the thickness of the wire being one-quarter of this. It weighs 5 mg and at 1 V takes 25 mA. Although developed for use in miniaturized electronic apparatus, it may have medical and other applications.

J.W.T.Walsh

621.327.534 : 621.387

EFFECT OF MAGNETIC FIELD ON MICROWAVE NOISE IN GLOW-DISCHARGE TUBES. See Abstr. 5711

621.327.534.15

6125 BRIGHTNESS REGULATION OF FLUORESCENT LAMPS. O.Becker.

B.B.C.Nachr., Vol. 42, No. 2, 100-7 (Feb., 1960). In German.

Describes methods of controlling the light output from a fluorescent lamp, using a pair of thyratrons so connected in the lamp circuit that the fraction of time for which the lamp is alight can be altered by means of a phase bridge. Instead of altering the length of time of the discharge, the amplitude of the current through the lamp may be varied by means of a d.c. bias on the ballast.

J.W.T.Walsh

621.327.534.15

6126 ELECTROMAGNETIC REGULATION OF FLUORESCENT LAMPS. C.H.Sturm.

B.B.C. Nachr., Vol. 42, No. 2, 108-12 (Feb., 1960). In German.

Describes the system of regulation in which the light from the lamp is varied by adjusting the value of a d.c. bias in the lamp ballast. For full-range regulation of a 40 W, 4 ft lamp a magnetizing current of up to 120 mA is required; the lamp current can then be varied over a range of 1000 : 1, the corresponding range of light output being 660 : 1.

J.W.T.Walsh

621.327.534.15 : 621.317.333

6127 VOLTAGE TEMPERATURE LIFE TESTING OF FLUORESCENT BALLAST INSULATION SYSTEMS. C.A.Howlett.

Trans Amer. Inst. Elect. Engrs II, Vol. 79, 37-40 (1960) = Applic. and Industr., No. 47 (March, 1960).

Choke life-tests, commenced in 1953, were carried out by simultaneous application of self-heating by the passage of current and external heating by means of an oven. Voltage was applied continuously, with the exception of short interruptions at five-minute intervals by means of mercury switches giving high-voltage transients. Comparisons were made between two kinds of enamel, interleaved and pile-wound coils, asphalt-filled ballasts and varnish-impregnated open types over a range of temperatures. Curves of regression of life on temperature are given, in most instances illustrating a halving of life for a 10°C rise in temperature. The good performance of the standard asphalt-filled interleaved ballast is demonstrated. The effects of exposure to humidity are also included and an estimate is made of the ballast performance required to ensure an average service life of 12 years.

C.E.Williams

ELECTROCHEMISTRY

621.355.8

6128 INVESTIGATIONS ON THE REACTION MECHANISM OF THE NICKEL–CADMIUM CELL. S.U.Falk.

J. Electrochem. Soc., Vol. 107, No. 8, 661-7 (Aug., 1960).

X-ray diffraction patterns from electrodes submerged in electrolyte were obtained during charge and discharge by means of a special test cell, and the composition of the active materials was determined. The question whether CdO or $Cd(OH)_2$ is formed during discharge was subject to special attention. The low potential reaction of the positive plate was studied. The e.m.f. and the dE/dT were determined between −40° and +50°C at various states of charge.

621.355.8

6129 MINIATURE GASPROOF NICKEL-CADMIUM BATTERIES. J.Mrha.

Slaboproudy Obzor, Vol. 21, No. 6, 358-63 (1960). In Czech.

A thorough investigation of a number of non-Czechoslovak-made miniaturized storage batteries was carried out and the results are indicated in five tables. It is concluded that the German DEAC batteries are the most satisfactory in that they are adequately gasproof and therefore have the longest life. A button-shaped Czechoslovak battery, having a capacity of 225 mAh, nominal voltage of 1.26 V and maximum discharge current of 45 mA was developed. The positive electrode of the battery is made of pressed active material (Ni hydroxide, graphite, activator) and is wrapped in nickel-wire gauze. The negative electrode is made of Cd oxide, Fe oxides and activators and is also wrapped in Ni gauze. The electrodes, together with KOH electrolyte, are enclosed in a nickelized receptacle. The total weight of the battery is 12 g.

R.S.Sidorowicz

ELECTRIC HEATING

621.362 : 537.32

6130 PERFORMANCE OF A THERMOELECTRIC CONVERTER UNDER CONSTANT HEAT FLUX OPERATION. P.S.Castro and W.W.Happ.

J. appl. Phys., Vol. 31, No. 8, 1314-17 (August, 1960).

The performance characteristics of a conventional thermoelectric generator operating under constant heat flux conditions were computed. Expressions for power output, optimum efficiency, and optimum ratio of internal-to-load resistance show that optimization requires operating conditions appreciably different from those for the operation of thermoelectric generators having constant hot- and cold-junction temperatures. Performance curves are presented for the optimum ratio of internal-to-load resistance when either the internal resistance or the load resistance is under the control of the designer.

621.362 : 537.533

6131 GENERATION OF ALTERNATING CURRENT IN THE CESIUM CELL. H.L.Garvin, W.B.Teutsch and R.W.Pidd.

J. appl. Phys., Vol. 31, No. 8, 1508-9 (Aug., 1960).

Oscillations of frequencies around 10^8 c/s were observed in a plane-parallel Cs diode used for energy conversion. The oscillations occurred in the constant current part of the characteristic. Experiments on the nature of the phenomenon are in progress.

A.H.W.Beck

621.365.2

6132 THE DETERMINATION OF THE ELECTRICAL CHARACTERISTICS OF AN ARC FURNACE. J.Ravenscroft.

Proc. Instn Elect. Engrs, Paper 3328 U, publ. Sept., 1960, 9pp. To be republished in Vol. 108 A (1961).

Describes three different methods for the determination of the electrical characteristics of arc furnaces. A comparison is made between the three methods by applying each in turn for the determination of the electrical characteristics of a 10 cwt Heroult-type 3-phase arc furnace. In the first method the characteristics are obtained directly from observations on the furnace during normal operation and under short-circuit conditions; in the second method the furnace curves are calculated by using an equivalent circuit for the 3-phase arc furnace; the third and most simple method treats the furnace as a balanced 3-phase load and utilizes a current-locus diagram to calculate operating points on the characteristics. For the 10 cwt furnace the simple locus-diagram treatment gave results of sufficient accuracy for all practical purposes, and the characteristics show that the furnace is most efficient, electrically, when operated on the highest voltage tapping.

621.365.2

6133 CRATER RESISTANCE OF SUBMERGED ARC SMELTING FURNACES SIMULATED BY A SIMPLE MODEL. O.C.Bockman.

J. Electrochem. Soc., Vol. 107, No. 8, 688-91 (Aug., 1960).

An electrolytic trough technique has been used to study the effect

of size and shape of the smelting crater on the ohmic resistance of the crater of submerged arc smelting furnaces. The ohm-inch rule is demonstrated, and the correct use of this rule is discussed.

621.365.41

6134 CONCERNING ELECTRICALLY HEATED BRIDGES. P.Miram.

Elektrizitätsverwertung, Vol. 35, No. 3, 101-3 (March, 1960). In German.

The Murgbridge design was used as an illustration of the problems involved in accurately estimating the quantity of energy required per unit area of road surface to melt a layer of ice of a few mm thickness. In this case the heating elements were embedded in a concrete layer about 8 cm thick and the quantity of heat and the heating time (~ 8 hr.) calculated on the basis of a final surface temperature of +2° C. The factors (spec. heat, thermal cond. etc.) governing these results are considered separately. A.J.Rouse

621.365.5

6135 THE INTERNAL IMPEDANCE OF AN INDUCTION FURNACE AT HIGH FREQUENCY. H.Buchholz.

Arch. Elektrotech. (Berlin), Vol. 45, No. 3, 162-8 (1960). In German.

When the influence of the resistance and inductance of the exciting winding are neglected and certain conditions concerning the physical dimensions of an induction furnace are fulfilled, it is possible to express the effective impedance of the furnace as an integral containing the term $\sqrt{(s^2 + 1)} - s$ where s is the dimensionless integration variable and $i = \sqrt{-1}$. A solution of this integral is best obtained by replacing this term by a Mellin integral. It is now possible to evaluate the integral by reversing the order of integration and the convergence of the series obtained is examined. The expression which is thereby derived for the internal impedance may be tested for correctness by letting the winding height tend to infinity. A.S.Hay

ELECTRIC WAVES AND OSCILLATIONS

621.371

6136 RECIPROCITY THEOREMS FOR ELECTROMAGNETIC FIELDS WHOSE TIME DEPENDENCE IS ARBITRARY. W.J.Welch.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 68-73 (Jan., 1960).

Two reciprocity theorems are derived which are valid for fields whose sources may have arbitrary time dependence. The first theorem involves the electromagnetic potentials, and the second is in terms of the electric and magnetic fields directly. In both cases, it is necessary to make use of the advanced as well as the retarded solutions to Maxwell's equations. Some properties of the theorems are discussed, and, as an application, the second theorem is used to derive a variational expression for scattering of electromagnetic waves from a perfect conductor.

621.371 : 538.56

6137 ELECTROMAGNETIC WAVES. V.Twersky.

Phys. Today, Vol. 13, No. 7, 30-6 (July, 1960).

Report of a conference held in Toronto, June 1959 under the tital, "International Symposium on Electromagnetic Wave Theory". It was sponsored jointly by the Union Radio Scientifique Internationale and the University of Toronto. There were 65 papers dealing generally with something, surface waves and aerials.

LINES . NETWORKS . FILTERS

621.372 : 538.56

6138 NEW DEVELOPMENTS IN MICROWAVE PHYSICS. H.Severin.

Naturwissenschaften, Vol. 47, No. 10, 217-21 (1960). In German.

Historical survey of the developments from Maxwell to the present day. In particular, an account is given of advances made in the ferromagnetic materials, their composition and characteristics (illustrated freely by graphs) and their application to microwave devices. The principles of operation of a parametric amplifier are explained. 22 references. Z.F.Voyner

621.372.2

6139 CIRCUIT PHYSICS [Physique des Circuits]. P.Grivet and R.Legros.

Paris: Masson et Cie (1960) 553 pp. (Cours d'Electronique. I). In French.

A textbook dealing mainly with the practical realization of electrical circuits. Basic circuit theory is covered, including resonant circuits, coupled circuits, Thevenin's theorem, impedance matching etc. Considerable attention is paid to the problems of design of fixed and variable capacitors, resistors and inductors of various types: the latter include coils with air-cores and also with laminated or ferrite cores. The theory of skin-effect in conductors and of eddy-current shielding in transformer cores and screens is dealt with in general terms. A comprehensive list of references is included. V.G.Welsby

621.372.2

6140 FLOW-GRAPH SOLUTIONS OF LINEAR ALGEBRAIC EQUATIONS. C.L.Coates.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 170-87 (June, 1959).

A weighted, oriented topological structure, denoted by G and called a flow graph, is associated with a set of m equations in n variables, denoted by $KX = 0$, such that K is a connection matrix and X a vertex weight matrix of the associated graph. This same set of equations can be written as $A^{-}_{-V}C(A^{+})'X = 0$ where A^{-}_{-V} and A^{+} are negative and positive incidence matrices and where C and X are respectively branch and vertex weight matrices of the graph. By familiar algebraic procedures, an expression for the weight x_p, of a non-reference vertex of G is obtained as a linear combination of the weights of the reference vertices (vertices with zero negative order) and can be written as

$$x_p = \sum_{j=1}^{\phi} \zeta_{p,\, rj} x_{rj}$$

To these algebraic results there correspond topological expressions in terms of sub-graphs of G for the coefficients ζ. A similar correspondence is obtained between the topological operation of deleting a vertex from the flow graph and the algebraic operation of eliminating a variable from the set of equations. These results are derived from the algebraic equations written in terms of the incidence and weight matrices of the graph. They are similar to those given for the familiar signal-flow graph, although they are more convenient to use, since the topological properties of the flow graph depend only upon the algebraic properties of the set of equations. A flow graph can be drawn directly from an electric network diagram, and the flow-graph properties used to obtain a solution of the network equations. Examples of this for two types of feedback networks are shown.

621.372.2

6141 TRIODE NETWORK TOPOLOGY. A.W.Keen.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 188-96 (June, 1959).

The 0- and 1-cell elements of topology are identified with a single terminal-pair and a two-terminal-pair transmission network, rather than with a single-terminal (or node) and a one-terminal-pair (or branch), respectively, in order to facilitate topological consideration of unilateral transmission networks, as typified by the triode valve. It is shown that even the simplest triode network has a feedback interpretation; in more general networks, several signal transmission loops may be distinguished, including both inverting and non-inverting unilateral paths.

621.372.2

6142 ON REALIZABILITY OF A CIRCUIT MATRIX. R.B.Ash and W.H.Kim.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 219-23 (June, 1959).

Methods of testing the realizability of a matrix as the circuit matrix of a linear connected graph are presented. Several theorems pertaining to realizability are derived. A systematic synthesis procedure is illustrated for a restricted class of matrices.

621.372.4

6143 ON THE REPRESENTATION OF TRANSIENTS BY SERIES OF ORTHOGONAL FUNCTIONS.

H.L.Armstrong.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 351-4 (Dec., 1959).

When problems having to do with transients are solved by the Laplace transform or equivalent methods, the necessity of solving a rather complicated equation in the transform variable may arise. This may be avoided, in many cases, by getting the solution in the form of a series. Laguerre functions have had some use for that purpose. It is shown here how another set of functions, which are just the Jacobi polynomials whose argument is an exponential, may be used instead. The use of this latter set permits a rather elegant means of evaluating the coefficients in the expansion to be used. In an appendix, ways of applying the mathematical techniques used are investigated. These involve the complex "Faltung" theorem, for investigating questions of orthogonality and orthonormality in general.

621.372.41

6144 TWO-TERMINAL RC NETWORKS AND THEORETICALLY RELATED TOPICS. O.P.D.Cutteridge.

Proc. Instn Elect. Engrs, Monogr. 374M, publ. April, 1960 (Vol. 107C, 275-82, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3502 of 1960.

621.372.412

6145 COUPLED VIBRATIONS IN ELECTROSTRICTIVE VIBRATORS OF RECTANGULAR AND CYLINDRICAL TYPE. S.Hayashi, K.U-O and S.Hoshino.

E.T.J. Japan, Vol. 5, No. 2, 46-50 (1959).

Formulae for the resonant frequencies (previously obtained by analogy with the electrically coupled resonant circuit) are obtained using special mathematical techniques to solve the three dimensional equations. Experiments with $BaTiO_3$ vibrators show good agreement between the formulae so derived and experimental results. Approximations for the resonant frequencies of the flat disk and the rod-shaped cylinder are also derived. A.P.G.Thiele

621.372.412

6146 EXCITATION OF PIEZOELECTRIC PLATES BY USE OF A PARALLEL FIELD WITH PARTICULAR REFERENCE TO THICKNESS MODES OF QUARTZ. R.Bechmann.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1278-80 (July, 1960).

The parallel field excitation of piezoelectric plates, particularly of plates vibrating in thickness modes, and their resulting piezoelectric stress constants in general and of various quartz cuts are considered. Quartz AT-cut crystals excited by a parallel field are of practical interest for high-precision frequency control and the data of the equivalent electric circuit of 1 Mc/s AT quartz oscillator excited by a parallel field are given.

621.372.5

6147 APPLICATIONS OF ROUTH'S ALGORITHM TO NETWORK-THEORY PROBLEMS. W.D.Fryer.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 144-9 (June, 1959).

The well-known Routh's criterion uses a very efficient computational method which has been found to reduce greatly the calculations and chances of error in a number of other important applications to circuit theory. These applications include finding common factors of polynomials, computing Sturm's functions, synthesizing RC, RL, or LC ladder networks by means of continued-fraction expansions, determining RC, RL, or LC realizability of a given immittance function, and analysis of ladder networks. Methods of handling the first two problems, both in normal and special cases, are given and illustrated.

621.372.5

6148 ON THE OPTIMUM PERFORMANCE OF VARIABLE AND NONRECIPROCAL NETWORKS.

T.Schaug-Pettersen and A.Tonning.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 150-8 (June, 1959).

Lossless, reciprocal transformations of two-state and nonreciprocal two-ports are discussed (two-state networks are networks whose parameters may be switched simultaneously between two different values). The minimum loss of such networks for various applications is shown to depend upon a single characteristic number which is invariant under the transformations studied. When a two-state or nonreciprocal material is used to realize such a network, there is an upper limit for the value of the characteristic number, and this is defined as a figure of merit for the material.

621.372.5

6149 A POWER THEOREM ON ABSOLUTELY STABLE TWO-PORTS. G.E.Sharpe, J.L.Smith and J.R.W.Smith.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 159-63 (June, 1959).

The stability criteria of two-ports are briefly reviewed, and the activity of two-ports is then discussed at some length. It is found that the real power available from an absolutely stable two-port for a fixed input excitation and passive load cannot exceed a maximum value. This maximum value is only obtained when the two-port is unilateral and has its parameters on the stability boundary. A "figure of merit" for active two-ports can now be defined in terms of "maximum absolutely stable power gain".

621.372.5

6150 TIME-RESPONSE CHARACTERISTICS OF A SYSTEM AS DETERMINED BY ITS TRANSFER FUNCTION.

J.D.Brule.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 163-70 (June, 1959).

A study is made of the step and impulse responses of systems whose transfer functions have all their poles on the negative real axis. The effects that real zeros of the transfer function have on the system response are evaluated. One result shows that if the transfer function has n finite zeros, all on the positive real axis, then the step response of the system has exactly n zero crossings. These step-response characteristics are studied further to establish upper and lower bounds on the position of the zero crossing for the case $n = 1$, and other bounds on the time functions for the cases $n = 0$ and $n = 2$.

621.372.5

6151 APPLICATION OF MELLIN AND HANKEL TRANSFORMS TO NETWORKS WITH TIME-VARYING PARAMETERS.

F.R.Gerardi.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 197-208 (June, 1959).

Mellin transforms may be applied to networks which yield the Euler–Cauchy differential equation. This transform will simplify the solution of such an equation. A transform table, similar to that type used in Laplace transform theory, is developed and applied to network problems. Hankel transforms may be applied to networks which yield the Bessel differential equation or variations of this equation. Unlike the Laplace and Mellin transforms, the Hankel transform is symmetric and the transformed variable is a real, rather than a complex variable. A transform table of both operations and functions is developed and applied to network problems as before. Three methods can be used to establish the table of transform pairs. They can be described as: performing the integral operation, applying the table of operations on known transform pairs, and deriving the Hankel transform from the Laplace transform. With both transforms, the applications are made to problems in analysis, instrumentation, and synthesis.

621.372.5

6152 MINIMAL REALIZATIONS OF THE BIQUADRATIC MINIMUM FUNCTION. S.Seshu.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 345-50 (Dec., 1959).

Rigorously minimal realizations of the biquadratic minimum positive real function are obtained without the use of the transformers. A few theorems are proved about the structure of the network realizing a minimum pr function. This is followed by an exhaustive search of networks in increasing order of number of elements. It is proved that the modified Bott-Duffin (or the Reza-Pantell-Fialkow-Gerst) realization using seven elements is rigorously minimal in number of elements, except for the special cases $Z(0) = 4\,Z(\infty)$ and $Z(\infty) = 4\,Z(0)$. These two special cases have five element realizations.

621.372.5

6153 NETWORK FUNCTIONS WITH A CONSTANT IMAGINARY PART. H.J.Orchard.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 370-4 (Dec., 1959).

Considers the problem, suggested by the circuitry of the so-called seven-league oscillator, of constructing a positive-real rational function whose imaginary part makes an equal-ripple approximation to a constant value over a wide band of frequencies. It gives an exact solution using elliptic functions and shows that the resulting function satisfies the conditions for realization with either an RL or an RC circuit. Performance curves and computing details are included.

621.372.5

6154 GENERALIZATIONS OF THE CONCEPT OF THE POSITIVE REAL FUNCTION. A.H.Zemanian.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 374-83 (Dec., 1959).

Two generalizations of the concept of the positive real function are made that are applicable to transfer functions whose poles outnumber their zeros by any amount. Some previously published results are briefly discussed. The second generalization is then developed still further. In particular, the properties of the zeros on the imaginary axis are established and are found to be analogous to the corresponding properties for positive real functions. In addition, several new tests for the generalized functions are developed, one of which serves as a new test for positive real functions wherein the Sturm sequence is replaced by a more easily calculated sequence. Reza's "double alternation" property for positive real functions is extended to the generalized functions. Finally, a property of the phase functions of the positive real functions is extended and the use of some common transformations is discussed which, in turn, leads to still another type of generalization.

621.372.5

6155 ON COEFFICIENTS OF POLYNOMIALS IN NETWORK FUNCTIONS. S.L.Hakimi and W.Mayeda.

I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 40-4 (March, 1960).

Presents a study of the relationships between the missing powers of polynomials in network functions and network geometry. The elementary transformation of trees and 2-trees of a network is introduced to obtain the necessary and sufficient conditions for polynomials in network functions to have missing powers. It is shown that the polynomial in the numerator of the transfer function of a grounded two-terminal-pair RLC network cannot have two successive missing powers unless some common factors of the numerator and the denominator are cancelled. This result is useful in topological synthesis where one must usually restore all the necessary surplus factors before deciding on the minimum number of vertices and the geometry of the network.

621.372.5 : 621-5

6156 OPTIMUM ESTIMATION OF IMPULSE RESPONSE IN THE PRESENCE OF NOISE. M.J.Levin.

I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 50-6 (March, 1960).

The problem considered is that of estimating the impulse response of a linear system from records of its input and output during a limited interval of time when the system output is obscured by additive random noise. Standard results from statistical estimation theory are applied to derive least squares and Markov estimates which are optimum in the sense of having minimum variance among all linear unbiased estimates. No special assumptions are required concerning the form of the input. Expressions for the variances of the sampling errors are given. The relationships of these estimates to other methods of estimation which have been suggested are discussed.

621.372.5

6157 A MODIFIED SYNTHESIS PROCEDURE FOR TWO-TERMINAL PAIR NETWORKS. S.S.Forte.

Marconi Rev., Vol. 23, 59-64 (2nd Qtr, 1960).

In a recent paper (see Abstr. 1554 of 1959), a theorem was formulated for stating the necessary and sufficient conditions for a set of prescribed driving point and transfer functions to be realized as a simple symmetrical lattice structure with series impedances or shunt admittances at either end. These conditions are rather restrictive and modified conditions are given whereby the synthesis procedure can be extended, in a particular case, to sets of functions which do not necessarily comply with the original theorem.

621.372.5

6158 AN ANALOGY BETWEEN NON-LINEAR RESISTIVE AND LINEAR A.C. NETWORKS. D.G.Mayne.

Proc. Instn Elect. Engrs, Vol. 107 B, No. 35, 410-11 (Sept., 1960).

To every a.c.network there corresponds a nonlinear d.c. network in which the relations between the various nonlinear resistance elements are determined by the a.c.network. In certain simple cases the nonlinear resistance elements become duals and the analogy mentioned by Cherry (see Abstr. 244 of 1960) in a recent paper results.

621.372.5

6159 PHYSICAL REALIZATION OF IMPEDANCE MODELS WITH ACTIVE ELEMENTS. J.Čemus.

Prace Ustavu pro Elektrotechniku CSAV, No. 9, 66-73 (1958). In Czech.

In the investigation of the physical realization of a model the assumption of mathematical similarity between the system to be studied and the model is made. The model is supposed to be constructed of linear networks consisting of a finite number of linear elements. The analysis shows that, if the matrix of the equations representing the performance of the system is square and symmetrical, physical realization can be achieved. A step-by-step method is given for the design of models of systems whose behaviour can be expressed by a set of linear, algebraic equations with real or complex coefficients. The resulting model contains a minimum number of elements and does not contain inductances or transformers. Such a model can be conveniently operated in a broad band of acoustic frequencies. E.Erdélyi

621.372.5

6160 ADMITTANCE MODELS. J.Čemus.

Prace Ustavu pro Elektrotechniku CSAV, No. 9, 75-85 (1958). In Czech.

Network models based on node equations instead of loop equations have certain advantages as they use constant-current-generator power supplies. Admittance models can therefore be conveniently operated in the anode-resistance circuits of vacuum valves. Change-over switches may be used to measure the necessary node voltages with a single voltmeter. It is shown how, by the use of the duality principle of the loop and node methode of writing circuit equations, admittance models can be derived from the impedance schemes. Two methods of suitable transformations are explained. The first, denoted as the simply coupled admittance method, is used for simple circuits. More involved circuits can be designed by the so called multiply coupled circuit method. Step-by-step rules are given for the design of these analogues. The multiply coupled method enables the engineer to find models with a minimum number of elements without any transformers or other two-port coupling networks. E.E.Erdélyi

621.372.54 : 621.375.23

6161 COMPLEX AUTOCOMPENSATOR FOR ALTERNATING CURRENT. L.Ya.Mizyuk and V.I.Gol'dgefter

Elektrichestvo, 1960, No. 1, 80-5 (Jan.). In Russian.

A method is discussed for extracting weak alternating current signals in the presence of strong noise background by the use of suitable feedback amplifiers. T.Horrocks

621.372.54

6162 IMAGE PARAMETER SQUARE-FREQUENCY FILTER DESIGN. D.B.Pike.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 208-14 (June, 1959).

By homographic or bilinear transformations of the square frequency plane, it is shown that the image propagation behaviour of filters of reactive impedances can, on normalization to the bandwidth, be described independently of the relative bandwidth. A graphical filter design method, similar to the Kosowsky approximation method for filters of narrow relative bandwidth, is hence made available as an accurate method for any relative bandwidth. For relating critical frequencies of lattice impedances to the peaks of infinite attenuation, results combine the simplicity of the Kosowsky (approximate) formulae with complete accuracy for all relative bandwidths. Methods of treating reflection loss are given. In terms of the transformed square frequency variable, the image propagation bheaviour of any filter represents a whole class of filters from which, by homographic transformations, individual members may be formed as band-pass, high-pass, low-pass, or all-pass filters.

621.372.54

6163 ANALYSIS OF PERIODIC FILTERS WITH STATIONARY RANDOM INPUTS. H.Urkowitz.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 330-4 (Dec., 1959).

Presents formulae for computing the mean square value and other statistical properties of the output when the input is a stationary random function. The formulae involve the values of the input autocorrelation function at integral multiples of the basic delay and the sums of product pairs of the coefficients in the Z-transform power series. Simple algebraic forms result, making slide-rule computation feasible. The effects of internal noise are also considered by means of the same techniques. Specific formulae are derived for single and double cancellers, velocity-shaped cancellers, and sweep integrators.

621.372.54

6164 SYNTHESIS OF ELECTRICAL FILTERS FROM OPERATING PARAMETERS FROM ZOLOTAREV'S FRACTION. A.F.Ufel'man.
Radiotekhnika, Vol. 15, No. 5, 64-72 (May, 1960). In Russian.

Calculation of such filters is carried out by methods not necessitating the use of special functions. The definition of the required functions is followed by the solution of the characteristic polynomial of the filter. The values of the lumped parameters in the filter schematic are then determined. An example of such a calculation is given. Some conclusions are drawn concerning the characteristic of the resulting filter. Derivation of some of the formulae quoted is given in an appendix. T.Horrocks

621.372.542.2

6165 ELEMENT COEFFICIENTS FOR SYMMETRICAL TWO-SECTION FILTERS HAVING TCHEBYCHEFF RESPONSE IN BOTH PASS AND STOP BANDS. D.C.Pawsey.
I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 19-31 (March, 1960).

Element coefficients for a normalized symmetrical low-pass filter, having "equal ripple" response in both pass and stop bands, are presented graphically. The coefficients are plotted against the relative selectivity of the filter, with a loss factor as independent parameter. The interval between curves is sufficiently small to permit interpolation with an accuracy of ±1%. Frequency and impedance transformations are included to allow the elements of a practical filter to be derived from those of the appropriate normalized design. The loss function corresponding to a particular design is readily formulated in terms of the loss factor above and the appropriate frequencies of zero loss.

621.372.542.2

6166 THEORETICAL LIMITATIONS ON THE GAIN–BAND-WIDTH PRODUCT OF THREE-TERMINAL NETWORKS. J.J.Spilker, Jr.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 224-8 (June, 1959).

Wherever parasitic impedances are found shunting the terminals of a network, certain limitations on the electrical behaviour of this network can be found. Typically, these parasitic impedances might represent a transistor, vacuum tube, or some other loading effect. Theoretical limitations are derived for the gain–bandwidth product of passive linear three-terminal networks (not necessarily lossless) used as low-pass filters. An important use of these limitations is in determining the upper bounds on the performance of video amplifiers. Bode has considered limitations of this type for an important but restricted class of networks where the parasitic elements are purely capacitive, whereas in this paper, limitations are shown for arbitrarily parasitic impedances. One important application of this new generality is that limitations can now be established for transistor amplifiers. This development has required the use of a general resistance integral theorem, the derivation of which is given. Different limitations are indicated for RLC networks and those allowing mutual inductance. Examples are given.

621.372.542.21 : 537.3

6167 SOLUTION OF LADDER NETWORKS CONTAINING NON-LINEAR RESISTANCES. T.Kovattana and J.R.Barker.
Brit. J. appl. Phys., Vol. 11, No. 9, 437-9 (Sept., 1960).

A graphical method of solving network problems involving non-linear and/or negative resistances is described and fully developed for the case of ladder networks. Such networks have been used for the solution of non-linear differential equations, using an analogy based on finite differences, and examples are given of this application.

621.372.542.21

6168 MAXIMUM GAIN REALIZATION OF AN RC LADDER NETWORK. A.Paige and E.S.Kuh.
I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 32-40 (March, 1960).

Deals with the synthesis of the voltage transfer function of an unterminated RC ladder network. Given $A(p) = V_2/V_1 = K[N(p)/D(p)]$, the constraint on N and D is well-known and the realization procedure is straightforward. However, for many applications, it is important to realize the maximum possible gain (K_{max}) associated with a given transfer function. A method of determining K_{max} from the given A(p) is presented. Furthermore, it is shown that if the maximum gain occurs at d.c. or at infinite frequency, K_{max} can be realized exactly. If the maximum gain occurs at a finite frequency, K_{max} can be approached arbitrarily closely.

621.372.542.21

6169 A GENERAL CLASS OF MAXIMALLY-FLAT AMPLITUDE RESPONSE LADDERS. S.Deutsch.
I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 45-9 (March, 1960).

It is shown that the elliptical Chebyshev pole array defines a general class of maximally-flat amplitude functions when the number of poles approaches infinity. The infinite-order pole array can be realized as an infinite cascade of identical two-terminal ladders. The amplitude characteristic of the driving-point impedance of the two-terminal ladder is flat up to the nominal cut-off frequency, ω_0. Beyond ω_0, the exact shape of the amplitude characteristic is determined by the eccentricity of the original pole array. The two-terminal ladder is a low-pass R, L, and C structure that is infinitely long. Two special cases are considered: (1) when the pole array becomes linear, the ladder is a constant-k type; (2) when the pole array becomes circular, the shunt conductances and series resistances of the ladder rapidly taper toward zero while its C and L components taper toward a constant-k type.

621.372.542.21

6170 MAXIMALLY-FLAT TIME DELAY LADDERS. S.Deutsch.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 2, 214-18 (June, 1959).

The driving-point impedance for a maximally-flat time delay response is derived. The impedance is synthesized as an infinite low-pass LC ladder that starts with an $\epsilon\, G/\omega_0$ F shunt capacitor. The ladder elements rapidly taper toward a capacitance of $2G/\omega_0$ F and an inductance of $2R/\omega_0$ H. The impulse and step responses of the impedance are derived as a series of Bessel functions. A three-terminal maximally-flat time delay transfer impedance is also considered. The conditions for a smoothly-tapering ladder structure are given. The transfer impedance is synthesized as an infinite low-pass LC ladder whose first two shunt capacitors are $32G/(9\omega_0)$ and $\epsilon^2 G/(9\omega_0)$ F, respectively. The impulse and step responses of the transfer impedance are also derived.

621.372.57

6171 SYNTHESIS OF DRIVING-POINT IMPEDANCES WITH ACTIVE RC NETWORKS. I.W.Sandberg.
Bell Syst. tech. J., Vol. 39, No. 4, 947-62 (July, 1960).

A general method is presented for synthesizing driving-point impedances using RC networks and active elements. The procedure realizes any real rational driving-point function and leads to rather simple structures. Only one active device, a negative-impedance converter, is required. The synthesis of biquadratic impedance functions is considered in detail.

621.372.58

6172 REGENERATIVE MODES OF ACTIVE NETWORKS. E.S.Kuh.
I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 62-6 (March, 1960).

An active device with passive imbedding can produce natural frequencies in the right-half plane. In the design of regenerative circuits, it is important to find the permissible location of regenerative modes. The maximum real part of the natural frequency of an active device under arbitrary passive imbedding is determined. Furthermore, it is shown that this regenerative mode can actually be realized. For the case of a pentode, the required passive network is a gyrator.

621.372.6

6173 REGION OF MAXIMUM POWER IN A CIRCUIT WITH A NONLINEAR ELEMENT. M.E.Syrkin.
Elektrichestvo, 1960, No. 3, 68-72 (March). In Russian.

When a load resistance is supplied via a nonlinear element from a source of e.m.f., the power dissipated in the load is a maximum when the load resistance equals the dynamic resistance of the element (the optimum load, matching condition). This maximum is a function of the e.m.f. and can itself pass through a maximum with certain forms of characteristics of the non-linear element. These conditions are discussed and general expressions for optimum load, efficiency and maximum power are derived in terms of the element characteristics (voltage/current, resistance/current or resistance voltage). Graphical methods are suggested for calculation of the optimum load at constant e.m.f. or constant current and for determination of the absolute maximum. Graphs corresponding to the function $U = af^{\alpha}$ are illustrated as an example. Z.A.A.Krajewski

621.372.6 : 621-52

6174 APPLICATION OF THE THEORY OF ORTHOGONAL POLYNOMIALS IN TWO VARIABLES TO A MULTI-GAIN EQUIVALENT LINEARIZATION PROBLEM. J.L.Brown.
Proc. Instn Elect. Engrs, Monogr. 401M, publ. Sept., 1960. 4pp. To be published in Part C.

It is shown that the multi-gain representation for a single-valued non-linearity with multiple inputs as developed by Somerville and Atherton may be regarded as an approximation problem involving orthogonal polynomials in two variables. Two stationary random processes are considered, x(t) and y(t), possibly correlated, with a given second-order (zero-delay) joint probability density, p(x, y). If the input to a specified zero-memory non-linear device having the input/output characteristic $v_0(t) = f[v_i(t)]$ is x(t) + y(t), the relevant polynomials satisfy orthonormality conditions over the xy-plane with respect to p(x, y) as weighting function. An inherent minimum property of these polynomials then allows the equivalent gains to be determined directly in terms of the expansion coefficients of f(x + y) with respect to the polynomials. When x and y are uncorrelated, the gains reduce to the values previously obtained by Somerville and Atherton (Abstr. 4499 of 1958). A further property of the polynomials is sufficient to prove that zero-delay cross-correlation between the input and the error involved in the approximation is zero, and that this result remains true as the order of the approximation is increased.

621.372.6

6175 DIRECT SINGLE FREQUENCY SYNTHESIS FROM A PRESCRIBED SCATTERING MATRIX. D.C.Youla.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 340-4 (Dec., 1959).

Presents two techniques for synthesizing an n-port (at a single frequency) directly from its normalized scattering matrix without recourse to its associated impedance matrix. Both methods depend on standard matrix canonic forms. In the first one, all the loss is extracted immediately in the form of n resistors and the problem is reduced to the synthesis of a lossless 2n-port. The second makes use of the Jordan decompositon of a matrix and leads to a hybrid mixture of ideal transformers, reactances, gyrators and resistors. The only elements required for a complete synthesis are ideal transformers, lossless capacitors, inductors, and gyrators, and positive and negative resistors. It is shown that synthesis from a prescribed scattering matrix requires, in general, irrational operations (computation of eigenvectors, eigenvalues, etc.) whereas synthesis from a prescribed impedance matrix (if it exists) can be achieved with rational operations alone.

WAVEGUIDES

621.372 831 : 538.56

6176 COUPLING OF RECTANGULAR WAVEGUIDES BY MEANS OF A HOLE IN THE WIDE WALL.
A.N.Akhiezer.
Zh. tekh. Fiz., Vol. 30, No. 7, 851-4 (July, 1960). In Russian.

Obtains formulae (with empirical corrections) for the coupling between two guides by means of a single circular hole for arbitrary wall thickness, hole diameter and its distance from the guide axis The formulae are compared with experimental results in the 3 cm and the 8 mm bands, for $d/\lambda_g < 0.33$ (d = hole diameter; λ_g = wavelength in the guide); they can be used in design of directional couplers. J K.Skwirzynski

621.372.852.22

6177 THE PHYSICAL PRINCIPLES OF THE OPERATION AND THE THEORY OF A FERRITE RESONANCE-ISOLATOR.
R.Steinhart.
Nachrichtentech Z. (N.T.Z.), Vol. 13, No. 3, 119-28 (March, 1960). In German.

Ferrite properties are discussed by reference to their crystallographic structure. A theoretical analysis of a ferrite-filled waveguide magnetized perpendicular to the broad wall is given. Properties of waveguides partially filled with magnetized ferrite are discussed with the help of the formulae derived and curves obtained. A.E.Karbowiak

621.372.852.22

6178 EXPERIMENTAL INVESTIGATION OF FERRITE RESONANCE-ISOLATORS. R.Steinhart.
Nachrichtentech. Z. (N.T.Z), Vol. 13, No. 4, 183-91 (April, 1960). In German.

This is a summary of experimental results obtained on various arrangements of ferrite resonance isolators. The experimental set-up is described and the results of measurements of various parameters are presented in graphical form. A.E.Karbowiak

OSCILLATORS . PULSE GENERATORS

621.373.4

6179 GENERATION OF DAMPED HIGH-FREQUENCY OSCILLATIONS BY MEANS OF CONTROLLED THYRATRONS.
A.D.Artým and A.V.Donskoi.
Elektrichestvo, 1960, No. 1, 59-63 (Jan.). In Russian.

Due to a long deionization time, thyratrons are not capable of generating continuous oscillations above 5 to 10 kc/s. Circuits are described in which thyratrons may generate dampled oscillations of some tens and hundreds of kc/s at up to some tens of kW with high efficiency. They can be used in high-frequency heating, ultrasonics and some other industrial and medical applications. A.Woroncow

621.373.4

6180 QUALITATIVE ANALYSIS OF A NEW OSCILLATOR CIRCUIT. St.Vojtášec and K.Janáč.
Hochfrequenztech. u. ElektAkust., Vol. 69, No. 1, 11-17 (Feb., 1960). In German.

The oscillator described, with class A operation, possesses certain desirable properties with regard to frequency stability. The main contents deal with the qualitative analysis of the operation and parameters of the circuit, using mathematical as well as analogue differential-analyser methods. General conclusions and practical details are omitted. 5 references (3 in Russian). A.Reiss

621.373.4

6181 AMPLITUDES OF OSCILLATIONS GOVERNED BY A MODIFIED VAN DER POL EQUATION.
K.Klotter and E.Kreyszig.
Quart. appl. Math., Vol. 18, No. 1, 61-9 (April, 1960).

A general study of the properties of the solution of the modified Van Der Pol equation $\ddot{q}-(\operatorname{sgn}\dot{q})(k^2s)(1-\beta^2\dot{q}^2)+k^2f(q)=0$, $s>0$. The first integral of the equation can be simply deduced and by consideration of the second term of the equation (which governs the energy input and output of the system) it is shown that the oscillations described by the equation tend to a limit cycle. The maximum amplitudes of the oscillations are studied, particular attention being paid to the amplitude associated with the limit cycle. G.D.Sims

621.373.4

6182 AMPLITUDE-STABLE OSCILLATORS WITH AUTOMATIC GAIN CONTROL. A.A.L'vovich.
Radiotekhnika, Vol. 15, No. 4, 54-62 (April, 1960). In Russian.

The literature on this type of oscillator is reviewed and an estimate is given of the behaviour of an oscillator for what are described as high frequencies using a 6ZH9P valve. The effects of supply voltage, effect of amplifier gain and variations in the regulated diode heater voltage are considered. The conditions are calculated under which the contributions to the overall instability from each of these sources is less than 0.1%. S.C.Dunn

621.373.4

6183 LOCKING RANGE OF AN OSCILLATOR FOR DIFFERENT NONLINEARITIES. B.R.Nag.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 134-6 (1960) = Commun. and Electronics, No. 48 (May, 1960).

Dependence of the locking range of an oscillator on the character of the stabilizing nonlinearity is studied and it is shown that a lower-order nonlinearity provides a wider range.

621.373.42

6184 THE APPLICATION OF PHASE-LOCKING TECHNIQUES TO THE DESIGN OF APPARATUS FOR MEASURING COMPLEX TRANSFER FUNCTIONS. G.Thirup.
J. Brit. Instn Radio Engrs, Vol. 20, No. 5, 387-96 (May, 1960).

The theory of phase-lock synchronization is given briefly. Two devices for measuring complex voltage ratios are described. In the first, which has a frequency range 1-110 Mc/s, the voltage ratio to be measured is converted to a constant intermediate frequency of 450 kc/s. The frequency difference between the signal generator and the local oscillator is kept constant by coupling the tuning shafts mechanically and by a phase-lock synchronizing device; special means for extending the pull-in range, making use of a coarse and fine electronic adjustment, are described. The second instrument

has a frequency range of 30-700 Mc/s, and here the local and signal generators are free-running and are separately tuned manually. A double frequency-conversion system is used. The frequency of the second local oscillator, by means of a phase-lock device, is kept 450 kc/s below the frequency difference of the signal and first local oscillator. A description is also given of how the complex measuring results can be displayed on a cathode-ray tube.

621.373.421

6185 THE OPTIMIZATION OF R.C. VALVE OSCILLATORS. T.Zagajewski.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 4, 127-36 (Nov., 1959). In German.

A study of Wien bridge and phase-shift oscillators by the method of 2nd and 3rd harmonic coefficients shows that, in the former type, it is advantageous to make the impedances of the elements in the series arm greater than those in the parallel arm. The nonlinear coefficients decrease as the ratio a is increased, or, for a given distortion, a larger output can be obtained. In the phase-shift type, if the impedance of each stage of the feedback network is made a times greater than that of the preceding stage, lowest distortion is obtained with a < 1. It is found also that CR phase-shift networks give lower distortion than RC networks, and that 4-stage networks are no better than 3 stages. W.G.Stripp

621.373.421

6186 A MICROWAVE MEACHAM BRIDGE OSCILLATOR. W.R.Sooy, F.L.Vernon and J.Munushian.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1297-306 (July, 1960).

A microwave analogue of the low-frequency Meacham bridge oscillator, long known for its exceptional stability, is described. The incorporation of the resonant element of a feedback oscillator into an appropriate bridge circuit effectively multiplies the Q of the element and consequently the stability of the oscillator. The performance and design of an X-band oscillator consisting of a travelling-wave tube amplifier, a cavity, a microwave Wheatstone bridge, and a bolometer element are described, and experimental results are compared with theory. The application of the principle to ultrastable systems utilizing very high-Q molecular resonators and low-noise amplifiers is also discussed.

621.373.421.13 : 621.317.335.3

6187 ON THE SCOPE OF APPLICABILITY OF AN LC RESONANT CIRCUIT IN THE ANODE CIRCUIT OF A VACUUM TUBE GENERATOR CONTROLLED BY A PIEZOELECTRIC QUARTZ CRYSTAL FOR DIELECTRIC CONSTANT MEASUREMENTS. Z.Obuszko.

Acta phys. Polon., Vol. 18, No. 2, 161-4 (1959).

It is shown that an LC resonant circuit in the anode circuit of a vacuum tube controlled by a piezoelectric quartz crystal cannot be used unrestrictedly for the measurement of capacitance and dielectric constants. This method is limited by the dielectric losses and conductivity of the capacitor under measurement.

621.373.431.4

6188 FORCED OSCILLATION IN AN OSCILLATOR WITH TWO DEGREES OF FREEDOM. B.R.Nag.

Proc. Instn Elect. Engrs, Monogr. 398 E, publ. Sept., 1960, 5 pp. To be republished in Part C.

Resonance curves of an oscillator with two degrees of freedom and the criteria of stability of the synchronized state are determined theoretically by van der Pol's method of approximation and verified experimentally by an electronic differential analyser. An experimental method for obtaining the phase trajectories is described. Characteristics of oscillations outside the zone of synchronization are also described.

621.373.44

6189 SUBAUDIO SWEPT SIGNAL GENERATOR. M.Rosen.

Electronics, Vol. 33, No. 17, 67-8 (April 22, 1960).

A unijunction transistorized sawtooth generator provides a waveform whose amplitude increases linearly with time. When applied to the timing circuit of a transistor blocking oscillator the pulse repetition period varies linearly with time. The output from the blocking oscillator operates a bistable multivibrator; the output is filtered by a low-pass filter and fed to the emitter-follower output stage. J.MacCormack

621.373.44

6190 THYRATRON PULSE GENERATOR. S.Rozenstein.

Electronic Technol., Vol. 37, No. 7, 281-3 (July, 1960).

A pulse generator is described which uses a thyratron as an electronic switch in a novel circuit. Short pulses of exponential shape are produced at reasonable output stability within repetition rates from 1 c/s up to 12 kc/s. Simplicity of design and low power consumption suggest its use as a portable laboratory pulse generator.

621.373.44

6191 SOLID STATE GENERATOR FOR 2×10^{-10} SECOND PULSES. A.F.Dietrich and W.M.Goodall.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 791-2 (April, 1960).

Pulses of 2×10^{-10} seconds base duration are produced by differentiating a sharp step occurring when a diffused silicon mesa diode (see Abstr. 3005 of 1959) stops conducting. The repetition rate can be several hundred million per second. A.Sczaniecki

621.373.531.1

6192 RECENT DEVELOPMENTS ON MAGNETIC-COUPLED MULTIVIBRATORS. W.A.Geyger.

Trans Amer. Inst. Elect. Engrs I, Vol. 79, 106-12 (1960) = Commun. and Electronics, No. 48 (May, 1960).

In a static d.c. to a.c. converter employing a saturating transformer with rectangular-hysteresis-loop core material in conjunction with two switching transistors (magnetic-coupled multivibrators), the oscillation frequency is linearly proportional to the d.c. supply voltage. This fact is significant with regard to telemetering-transducer applications. However, the linear relation between d.c. input voltage and frequency of the square-wave output voltage is quite unfavourable in those cases, e.g., design of test circuits for magnetic amplifiers, where it is necessary to vary the oscillation frequency of the magnetic-coupled multivibrator independently, without changing magnitude of the supply voltage. The results are given of recent investigations concerning new circuits for magnetic-coupled multivibrators and their use at high frequencies, up to about 100 kc/s. These circuits make it possible to vary the oscillation frequency, within wide limits, without changing the magnitude of the output voltage and without impairing the output waveform, simply by connecting a saturating reactor with rectangular-hysteresis-loop core material in parallel to the load or across the collector terminals. Interconnection of a continuously variable transformer introduces linear frequency-control characteristics and permits coarse and fine adjustment with regard to frequency and magnitude of the square-wave output voltage.

PULSE CIRCUITS . DIGITAL CIRCUITS SWITCHING CIRCUITS

621.374.32

6193 COLD-CATHODE RING-COUNTER DRIVES NUMERICAL INDICATOR. P.G.Hodgson.

Electronics, Vol. 33, No. 14, 80 (April 1, 1960).

Ten Phillips Z70U trigger tubes are used in a decade counting circuit and the count is indicated on a Burroughs HB106 indicator tube. The maximum speed is 2500 p.p.s. J.MacCormack

621.374.32

6194 DISK ENCODER DESIGN AVOIDS AMBIGUITIES. D.P.Griffin.

Electronics, Vol. 33, No. 17, 62-6 (April 22, 1960).

Ambiguities in the reading of the output of an encoded disk may be avoided by increasing the effective number of tracks and take-off brushes. Methods of achieving non-ambiguous results, using internal or external logical circuits, are discussed. A.Q.Stanesby

621.374.32

6195 COUNTING AND TIMING CIRCUITS USE SATURABLE REACTOR. J.S.Sicko.

Electronics, Vol. 33, No. 19, 61-3 (May 6, 1960).

The control winding of a saturable reactor is connected in series with the gate of the control rectifier. When the control current builds up to a suitable value it turns on the rectifier. The anode current then flows and within one half cycle reverses the magnetization of the core by means of another winding. The initial condition is thus restored and anode current is cut off. The process is repetitive and an output pulse flows for every n supply cycles. The delay occurs during the building up of the control current and can be adjusted by altering the control voltage. On 400 c/s supply division by ten is possible. The operation is explained by means of equivalent circuits and a brief design theory is given. A.K.Podkolinski

621.374.32 : 621.387.424

6196 A TRANSPORTABLE MEASURING APPARATUS WITH GEIGER–MÜLLER COUNTERS. H.Mahnau.
Elektron. Rdsch., Vol. 14, No. 3, 87-9 (March, 1960). In German.

Describes a battery-operated, transistorized gamma-ray monitor of high sensitivity. Special features include the use of "Ferroxcube" impulse transformers placed near the Geiger counter; these permit the use of long coaxial cables between Geiger counter and measuring equipment. The useful temperature range is between -20° and $+44^{\circ}$ C. A.E.I.Research Laboratory

621.374.32

6197 LIGHT-PULSE COUNTER USING TRANSISTORS. A.Messiaen.
Rev. H.F., Vol. 4, No. 9, 210-14 (1960). In French.

The speed of the rotating mirror in Michelson's experiment was precisely measured by counting the rate of reflections impinging onto a phototransistor (at more than 800 times per sec.). The associated transistorized apparatus, including a 2 to 1 countdown circuit, is described. A.Sczaniecki

621.374.32

6198 COSINE-CUBED PULSES. M.S.Gurevich.
Radiotekhnika, Vol. 15, No. 5, 60-3 (May, 1960). In Russian.

Compares theoretically pulses described by the function

$$U(t) = A\cos^3\frac{\pi}{T}t \text{ for } -\tfrac{1}{2}T \leq t \leq +\tfrac{1}{2}T$$

$$U(t) = 0 \text{ for } |t| > \tfrac{1}{2}T,$$

with cosine and cosine-squared pulses and shows that their radiation outside the band decreases more rapidly with increasing frequency and that they have shorter set-up time. Their disadvantages are greater occupied band-width and less energy in the pulse. D.E.Brown

621.374.32 : 681.142

6199 A RANDOM NUMBER GENERATOR. H.Isaksson.
Teleteknik (English Edition), Vol. 3, No. 2, 25-40 (1959).

English translation of paper already abstracted as Abstr. 2950 of 1959.

621.374.32

6200 TRANSISTOR PULSE CIRCUITS FOR 160 Mc CLOCK RATES.
I. PULSE REGENERATION. W.J.Giguere and J.H.Jamison.
II. PARALLEL-TO-SERIAL MULTIPLEXING. J.C.Noll.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 432-5, 436-8 (Dec., 1959).

Pt I discusses transistor circuits capable of regenerating 6.25 mμsec pulses at a 160 Mc/s bit rate. Pt II discusses techniques for multiplexing 16 digital signals with a 10 Mc/s clock rate into a single signal with a 160 Mc/s clock rate. Two methods of performing the regeneration function are presented. One method consists of d.c. level restoration for recognition of the signal and constant-current coincident circuitry for the reconstruction of the pulses. The second method consists of operating on changes in the signal for pulse recognition and the use of a bistable circuit for pulse reconstruction. Timing in the second case is obtained by a constant-current coincidence gate. Parallel-to-serial multiplexing techniques were developed to combine sixteen parallel 10 Mc/s clock-rate signals into a 160 Mc/s clock-rate pulse train. The sixteen synchronous signals are applied to sixteen "and" gates along with a 10 Mc/s narrow gate pulse. The space separations of the resulting regenerated and timed "and" gate output pulses is converted to time separation with only a small amount of signal loss. This is done by injecting the pulses at sixteen equally separated points on a broad-band delay line. Methods were developed to reduce spurious responses resulting from multiple reflections on the delay line. The current mode transistor "and" gates are suitable for and/or functions for individual 4 mμsec logic. The multiplexer may also be used as a piece of test equipment to generate repetitive 16 bit binary words with a 10 Mc/s frame rate.

621.374.3

6201 SPECIFYING A PULSE TRANSFORMER FOR COMPUTER USE. R.R.Blessing.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 44-7 (1960) = Commun. and Electronics, No. 47 (March, 1960).

A pulse transformer to be used in the drive circuits of a magnetic-core store element has special requirements in freedom from overshoot, ripple and droop in the response to a trapezoidal current pulse input. The relationship between these requirements and the characteristics of the core material are discussed and it is concluded that the coercive force is determined by the required current pulse amplitude, the saturation flux density by its duration and the maximum permeability by its allowable droop. G.H.Stearman

621.374.32

6202 A NOTE ON THE NUMBER OF INTERNAL VARIABLE ASSIGNMENTS FOR SEQUENTIAL SWITCHING CIRCUITS. E.J.McCluskey, Jr and S.H.Unger.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 439-40 (Dec., 1959).

An important step in the synthesis of sequential switching circuits is the assignment of binary variable states to represent internal states of the circuit. A formula is derived here which indicates the number of different assignments which can be made for flow tables having a given number of rows. There are only three essentially different assignments possible for a four-row table, and there are 140 for a five-row table.

621.374.32

6203 ELECTRONIC DIGITIZING TECHNIQUES. G.J.Herring.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 513-17 (July, 1960).

Applications in which analogue-to digital conversion is required are discussed, and it is shown that convertors may be broadly classed as mechanical or electronic. Electronic converters are faster but in general less accurate than mechanical. The principle on which electronic convertors have been based are discussed, such as voltage feedback, time encoding and frequency modulation. Factors to be borne in mind in choosing a convertor for a particular application are reviewed.

621.374.32

6204 CONTRIBUTION ON THE NORMALIZATION OF CIRCUITS FOR ELECTRICAL INTEGRATION AND DIFFERENTIATION. K.H.Kerber.
Elektron. Rdsch., Vol. 14, No. 2, 49-50 (Feb., 1960). In German.

Circuits for electrical integration and differentiation require normalization to eliminate phase and amplification errors. A quasi-resonance circuit is described having the component values required for error-free operation. A quantity η is defined as the ratio of the signal frequency to the quasi-resonance frequency; the circuit behaves as an integrator for $\eta > 1$, and as a differentiator for $\eta < 1$. J. W.Gardner

621.374.32

6205 A SIMPLE ANALOGUE TO DIGITAL CONVERTER WITH NON-LINEARITY COMPENSATION. W.N.Jenkins.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 518-22 (July, 1960).

The convertor combines a high-speed electromechanical switch with a transistor switching amplifier. The electromechanical switch is a motor driven uniselector and a chain of high stability resistances is connected around the two levels of the switch to form a potential divider. A signal from this potential divider is subtracted from the unknown input voltage in the range 0-10 V and the difference appears across the input of the switching amplifier. When balance is reached the amplifier signal reverses in sign and the switching amplifier energizes a high-speed relay to stop the motor uniselector. Balance is achieved in 0.5 s and the accuracy of digitizing is 1 part in 100. The convertor is extremely flexible in output coding and gives complete nonlinearity compensation for any function with suitable connections on the spare levels of the motor uniselector. It is very simple and cheap to construct and can be used to digitize from most types of potentiometric recorder.

621.374.32

6206 AN ANALOGUE-DIGITAL CONVERTER WITH LONG LIFE. R.L.G.Gilbert.
J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 529-35 (July, 1960).

An instrument has been developed for converting small voltages representing a measured parameter into a digital representation of the parameter. Features of the instrument include a high input impedance, extremely long service-free life (due to lack of any moving parts), accuracy of 0.1% of full scale deflection, and conversion time of 25 ms or less. The instrument is unusual in that conversion is performed at the input level, thus eliminating the necessity for a d.c. amplifier with stable gain, and circuits have

been designed to "linearize" the outputs from copper–constantan or chromel–alumel thermocouples so that the output is in degrees centigrade rather than in thermocouple e.m.f. Some observations are made on the problems of switching low-level signals. Suggestions are made as to suitable uses for such convertors.

621.374.32

6207 A NEW CLASS OF SWITCHING DEVICES AND LOGIC ELEMENTS. P.R.McIsaac and I.Itzkan.
Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1264-71 (July, 1960).

With a new class of switching devices employing microwave tube elements, appropriate combinations of particular components can create a variety of devices that are capable of performing switching and logic at extremely high speeds (one operation per mμsec or less). Such speeds represent a large step forward in the computer art. A preliminary device described herein demonstrated the ability of a microwave signal to control a direct current. The goal of operating a computer with pulse trains dictated a choice of components that would provide large bandwidth with gain; therefore, an experimental travelling-wave interaction-type tube was built which demonstrated the ability of one microwave signal to control another.

621.374.32

6208 SWITCHING NETWORKS FOR DECODING BASED ON SEMICONDUCTOR ELEMENTS. E.Oehme.
Hochfrequenztechnik u. ElektAkust., Vol. 69, No. 2, 52-61 (April, 1960). In German.

Describes the principles of pulse-train decoding and error correction, together with their embodiment in terms of semiconductor elements. A.E.I. Research Laboratory

621.374.32

6209 ESAKI DIODE HIGH-SPEED LOGICAL CIRCUITS. E.Goto, K.Murata, K.Nakazawa, K.Nakagawa, T.Moto-oka, Y.Matsuoka, Y.Ishibashi, H.Ishida, T.Soma and E.Wada.
I.R.E. Trans Electronic Comput., Vol. EC-9, No. 1, 25-9 (March, 1960).

Logical circuits using Esaki diodes, and which are based on a principle similar to parametron (subharmonic oscillator element) circuits, are described. Two diodes are used in series to form a basic element called a twin, and a binary digit is represented by the polarity of the potential induced at the middle point of the twin, which is controlled by the majority of input signals applied to the middle point. Unilateral transmission of information in circuits consisting of cascaded twins is achieved by dividing the twins into three groups and by energizing each group one after another in a cyclic manner. Experimental results with the clock frequency at high as 30 Mc/s are reported. A delay-line dynamic memory and a nondestructive memory in matrix form are also discussed.

621.374.32

6210 HIGH-SPEED MAGNETIC SHIFT REGISTERS USING CURRENT STEERING. J.Neirynck and N.Rouche.
Rev. H. F., Vol. 4, No. 9, 201-9 (1960).

The principle of current-steering, as applied to magnetic-core shift registers, is developed from the conventional system using 2 cores per bit. Symmetric forms are also described, in which a constant load is imposed upon the shift pulse generator regardless of the binary pattern stored. One of these symmetric forms is such that there is virtually no upper limit upon the shift pulse current which may be used, so that higher speeds may be attained. A simplified theory of operation is proposed allowing reasonably accurate prediction of turns ratios and operating speed. Experimental results for practical registers are presented and compared with predicted figures. Shift-rates of 1.5×10^6/sec. have been realized. The current-steering principle, in both non-symmetric and symmetric forms, is shown to be well adapted to binary logical operations and a binary half-adder is described. G.H.Stearman

621.374.32

6211 BACK-TRANSIENT DIODE LOGIC. G.Wolff.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 4-9 (1960) = Commun. and Electronics, No. 47 (March, 1960).

When a diode is pulsed by a back voltage immediately following forward conduction, a finite time is required to attain a steady-state back resistance; this property can be used to improve diode logic circuits. A conventional n-input "and" gate is examined and it is shown that as the required switching speed increases relatively large currents are needed. The power which this represents is largely wasted since it is required for only a brief initial fraction of the total signal duration. Slight changes in the usual circuits enable them to be designed taking account of the back-transient property of the diodes and experimental circuits have been operated successfully up to 30 Mc/s. G.A.Montgomerie

621.374.32

6212 MAGNETIC ANALOGS OF RELAY CONTACT NETWORKS FOR LOGIC.
D.B.Armstrong, T.H.Crowley, U.F.Gianola and E.E.Newhall.
I.R.E. Trans Electronic Comput., Vol. EC-9, No. 1, 30-5 (March, 1960).

Two techniques are described for designing multiapertured magnetic structures capable of realizing any specific logic function. The structures are made from rectangular hysteresis loop material. The designs are derived from the corresponding relay contact network by replacing each current conductor in the relay circuit with its analogue in the magnetic circuit, a flux-carrying conductor, replacing the e.m.f. with a pulsed m.m.f.; and replacing each back contact with a saturable portion of the magnetic circuit in the topological equivalent of the contact network. A flux reversal through a saturated portion may then be blocked by means of an inhibiting current applied to a suitable winding, the current representing a logical input variable. Thus flux may be "steered" through the magnetic circuit in a manner analogous to the steering of current through the contact network. For planar structures the first technique may be used to obtain the analogue of series–parallel and bridge-type circuits; the second technique is suitable only for the analogues of series–parallel circuits. It is pointed out that the analogue of a relay tree can be used as a standard structure suitable for realizing any Boolean function. Representative examples of both designs are shown, and experimental data are given.

621.374.32

6213 THE "PERSISTOR" — A SUPERCONDUCTING MEMORY ELEMENT.
E.C.Crittenden, Jr, J.N.Cooper and F.W.Schmidlin.
Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1233-46 (July, 1960).

The basic components of a Persistor memory element are a superconducting inductor in parallel with a switch element which is normally superconducting, but which becomes resistive when the current exceeds a critical value. When a suitable current pulse is applied to a Persistor memory element, a persistent circulating current is stored. A second pulse in the same direction as the first makes no change, but a pulse in the opposite direction reverses the circulating current and produces a voltage across the element. By mutual inductance coupling to two or more driving circuits, these memory elements can be made to operate in matrices similar to those employed with ferromagnetic cores. Persistor memory elements utilizing lead inductors and thin tin or indium films have performed typical memory unit functions for pulses of 15 mμsec duration and a repetition rate of 15 Mc/s. Performance at higher speeds is possible. The limiting speed is determined by the thickness of the thin film switch element and can be made as fast as is useful for the other parts of the associated circuits. The elements are well suited to compact printed-circuit production, with densities of a million per cubic foot possible.

621.374.33 : 539.1.07

6214 TIME-SORTER FOR USE IN THE NANOSECOND RANGE. G.Jones.
J. sci. Instrum., Vol. 37, No. 9, 318-23 (Sept., 1960).

Presents the design of a time-to-amplitude conversion circuit employing delayed fast coincidence techniques for use in the nanosecond region. This circuit has a linear time calibration over the range 1 to 10 ns, a resolution time of less than 0.05 ns and a variation of time calibration less than 0.03 ns per day is achieved. A resolution time of 0.8 ns was found when detecting coincidence between γ-rays from a Co^{60} source.

621.374.4

6215 COMPARATIVE ASSESSMENT OF SERIES AND PARALLEL FREQUENCY DIVISION. Yu.N.Bakaev and P.I.Kuznetsov.
Radiotekhnika, Vol. 15, No. 4, 42-9 (April, 1960). In Russian.

It is shown that, under the conditions of interference, the series method of frequency division is more suitable. The properties of "group" division are established. The advantages of the parallel method are explained. The effects of continuous and impulsed interference are considered. A possible combination of schemes is suggested. T.Horrocks

621.374.5 : 534.21

6216 VARIABLE ULTRASONIC WATER DELAY LINE. G.W.Williams.

Brit. J. appl. Phys., Vol. 11, No. 8, 358-63 (Aug., 1960).

A variable delay line that uses ultrasonic propagation in water has been constructed. The delay, variable from 200 to 2600 μs, is controlled by an input voltage, and is variable at a rate of 40 μs/s. A bandwidth of 800 kc/s is achieved at the carrier frequency of 7 Mc/s. The delay is stable to better than 0.05% over the normal range of room temperatures. Automatic gain control holds the change in level of the output pulse to better than ±1 dB.

AMPLIFIERS

(Abstracts on magnetic amplifiers appear also under Inductors . Reactors)

621.375.121

6217 LIMITATIONS ON REALIZABLE RESPONSE SHAPES FOR CERTAIN WIDE-BAND BANDPASS AMPLIFIER CIRCUITS. R.A.Woodrow.

Proc. Instn Elect. Engrs, Monogr. 400 E, publ. Sept., 1960, 8 pp. To be republished in Part C.

A procedure is described for the design of wideband bandpass amplifiers using either stagger-tuned stages or a chain of feedback pairs to realize Chebyshev or Butterworth response shapes. A graphical test has been developed by which it is possible to verify, at the outset, that a given design specification is a realizable one. Certain fundamental limitations which are imposed upon the response shapes by the choice of these circuit configurations are revealed by this test. Thus it is shown that any response shape which may be realized by a chain of feedback pairs can also be realized with stagger-tuned stages, while the converse is not true.

621.375.13 : 621.317.373

GAIN-PHASE MEASUREMENTS IN FEEDBACK AMPLIFIERS. See Abstr. 6070

621.375.2

6218 FREQUENCY RANGE OF DIRECT CURRENT AMPLIFIERS WITH TRANSFORMERS.

K.B.Karandeev, L.Ya.Mizyuk and L.D.Gik.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 2, 329-32 (May 11, 1960). In Russian.

Methods of increasing the frequency range of direct current amplifiers are suggested. In particular, whereas a single semiperiodic scheme (of phase inversion) is in practice associated with the upper frequency range equal to the half of the transformation frequency, the authors show that the twice repeated semiperiodic scheme leads to a theoretically unlimited range of transmission, independently of the frequency of transformation. In practice, the upper frequency is nearly equal to the transformation frequency.

J.K.Skwirzynski

621.375.2

6219 DESIGN OF PULSE AMPLIFIER. R.C.Ganguli.

Indian J. Phys., Vol. 33, No. 6, 263-75 (June, 1959).

Describes a new approach to the design of pulse amplifiers based on transient-response characteristics. A pulse amplifier is characterized by its gain, risetime and overshoot and the design is dependent upon the relationship between these parameters and the circuit constants. An analytical relationship between overshoot and risetime (defined as the time for 10% to 90% of the final value) cannot be obtained. The relationship between gain, overshoot and the time to rise from zero to peak value has, however, been obtained, and the method of designing an actual pulse amplifier from a knowledge of these parameters is shown. Results are compared with an actual pulse amplifier designed from data obtained theoretically.

621.375.2

6220 THE PERFORMANCE OF A CASCODE I.F. AMPLIFIER. R.S.Richards.

Trans Engng Inst. Canada, Vol. 4, No. 1, 8-12 (1960).

Design information is given for building an i.f. amplifier using double triodes in a cascode connection. Among the advantages such a configuration possesses are: high gain–bandwidth product with inexpensive tubes; exceptional stability and agreement between predicted and actual performance.

621.375.2/.4

6221 GRAPHICAL CIRCUIT DESIGN ON SEMILOGARITHMIC PAPER. J.Karpinsky.

Sloboproudy Obzor, Vol. 21, No. 5, 265-8 (1960). In Czech.

It is pointed out that by plotting the current–voltage characteristics of thermionic valves or transistors on semilogarithmic paper [lg(Ia) against voltage], the region of small currents is significantly expanded. This is of importance in the design of the devices operating at low currents. However, the load line in semilogarithmic plot is no longer a straight line. This difficulty is overcome by using a transparent template with a "universal" load line which can be shifted into the required position. The characteristics of the phototransistors and detector diodes can also be conveniently plotted in semilogarithmic scale. R.S.Sidorowicz

621.375.23

6222 SINGLE-STAGE SELECTIVE AMPLIFIER WITH AMPLIFIED SELECTIVE NEGATIVE FEEDBACK. A.I.Belichenko.

Radiotekhnika, Vol. 15, No. 3, 53-7 (March, 1960). In Russian.

After a brief discussion of the well known double-T network RC selective amplifier in a two-stage version, a novel arrangement is described, where the double-T bridge is placed between the first and second stages, the output is taken from the anode of the first, the feedback voltage is taken from the second anode and fed to the first grid via a cathode-follower. The advantages are higher working Q and hence better selectivity. A full analysis of the circuit is given also a detailed circuit diagram of a practical amplifier. Application to very low frequencies is also considered. A.Landman

621.375.23

6223 FREQUENCY COMPENSATION OF WIDEBAND AMPLIFIERS BY FEEDBACK. L.B.Ustinova and Z.N.Luzyanina.

Radiotekhnika, Vol. 15, No. 6, 24-35 (June, 1960). In Russian.

Describes the use of multiple feedback, both positive and negative, to increase the gain–bandwidth factor of wideband amplifiers. Conditions of stability are determined for circuits described by a third-order equation. Formulae for the optimum gain–bandwidth factor are derived and an example is presented to illustrate the choice of parameters. Comparisons are made between this method and the use of inductors to increase the gain–bandwidth factor. It is found that for circuits described by third-order equations both methods give the same maximum gain–bandwidth factor. Circuits with multiple feedback are simpler to construct than these with inductor compensation but have a disadvantage that the value of positive feedback depends on the internal impedance of the signal source. B.Dentskevich

621.375.23

6224 AN ANALYTICAL METHOD OF DETERMINING POLE LOCATIONS OF CERTAIN TYPES OF FEEDBACK AMPLIFIERS. R.L.Gamblin.

Trans Amer. Inst. Elect. Engrs II; Vol. 79, 41-4 (1960) = Applic. and Industr., No. 48 (May, 1960).

The pole locations of feedback amplifiers of an arbitrarily large number of stages, but with only one or two characteristic time constants, can be solved analytically. The resulting expression is then general for all of one class of amplifiers. A solution of the case of n stages of one time constant and m stages of another with $n/m \gg 1$ is presented. The case with m = 1 and with ideal matched transmission lines in the loop is also solved. Other cases presented are for m = 0 and m = n. The analysis is shown to be good for high- or low-frequency investigations where the system bandwidth is broad enough to prevent high- and low-frequency response interference.

621.375.3

6225 STATIC RELAYS USING MAGNETIC AMPLIFIERS. J.L.Hétier.

Bull. Soc. Franc. Elect. (Ser.8), Vol. 1, No. 4, 240-8 (April, 1960). In French.

The principles of logical control are explained and illustrated by a simple example. The use of auto-excited magnetic amplifiers forming the basic "and" and "no" elements is described, followed by a discussion of performance limits, construction and some production details. Examples of industrial applications are given. A.K.Podkolinski

621.375.4

6226 CALCULATION OF THE FREQUENCY RESPONSE OF A NON-LINEAR TRANSISTOR AMPLIFIER. I.Gumowski.
C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4322-4 (June 27, 1960). In French.

Application of the Poincare method to the solution of the differential equation describing the non-linear behaviour of a transistor amplifier yields a periodic solution in the form of a power series in terms of a parameter. S.A.Ahern

621.375.4

6227 PREAMPLIFIER DESIGNED FOR MINIMUM POWER CONSUMPTION. C.D.Todd.
Electronics, Vol. 33, No. 18, 106-7 (April 29, 1960).

A three-stage silicon transistor (2N1229), RC-coupled amplifier is described in detail. The power consumption is 750μW, variable gain 20-5,000, input resistance 0.5 megohms, frequency response is flat from 1 c/s-18kc/s for a gain of 100. With a generator resistance of 50 kohms the equivalent noise input is 2μV. J.MacCormack

621.375.4

6228 TRANSISTOR CURRENT AMPLIFIERS FOR ANALOGUE COMPUTATION. M.Mancianti and G.Salardi.
Energia elett., Vol. 37, No. 3, 216-21 (March, 1960). In Italian.

The principles of current-operated operational amplifiers are discussed and an experimental amplifier is described. C.Fromberg

621.375.4 : 621.382.3

6229 EQUIVALENT CIRCUITS FOR TRANSISTORS DRIVEN AS LINEAR AMPLIFIERS. W.Benz.
Elektron. Rdsch., Vol. 14, No. 1, 5-9 (Jan., 1960). In German.

Offers a survey of equivalent circuits, describes their characteristics and gives basic circuits and quadripole equations. The physical equivalent circuit of an ideal transistor as well as the motions of charge carriers (hole current, minority and majority carriers) inside the semiconductor material and the barrier layer are then considered in more detail. After a few simplifications a practical circuit emerges, as given by Zawels (see following abstracts) which is then correlated with the well known circuits of Early, Pritchard and Giacoletto: it is concluded from this comparison that Zawels' and Giacoletto's circuits are to be preferred, each on its own merits. Finally the principles of the internal transistor path impedances and barrier-layer capacitance are stated. A.Reiss

621.375.4

6230 EQUIVALENT CIRCUITS FOR TRANSISTORS DRIVEN AS LINEAR AMPLIFIERS. W.Benz.
Elektron. Rdsch., Vol. 14, No. 2, 59-64 (Feb., 1960). In German.

(See preceding abstract). Deals with the practical circuits which are less complicated and gives approximation formulae for the calculation of parameters. A few examples show how circuit elements in one configuration may be derived from another. The usefulness of given practical circuits and their application limits are finally discussed. A.Reiss

621.375.4

6231 ANALYSIS OF THE USEFULNESS OF ZAWELS'S PRACTICAL EQUIVALENT CIRCUIT. O.Müller.
Elektron. Rdsch., Vol. 14, No. 3, 90-4 (March, 1960). In German.

Formulae for the "h" and "y" parameters are given for Zawels's equivalent circuit, as described by Benz (see preceding abstract). From these are obtained simple relations for the determination of circuit elements. The "y" parameter for the base- and emitter-circuit of a h.f. transistor is calculated beyond the α cut-off frequency by means of the above internal parameters and a comparison made between measured and calculated values, with very good agreement. The "h" parameter for the same two basic circuits is also given as locus plots. A.Reiss

621.375.4

6232 TRANSISTORS IN AUDIO- AND CARRIER-FREQUENCY AMPLIFIERS. K.Lamont.
Electronic Technol., Vol. 37, No. 8, 292-9 (Aug., 1960).

Discusses the characteristics of common-emitter transistor amplifiers in relation to the specific requirements of communication systems. In audio and carrier telephone applications, it is necessary that the amplifiers shall have a constant gain, that input and output impedance shall remain reasonably close to specified values and that the distortion products shall be very small, typically 60 dB below the fundamental of any frequency in the pass-band. These performance characteristics are normally required to be met up to temperatures of +55°C, perferably with germanium transistors. Practical methods of stabilizing both the bias point and the gain of a single stage are discussed, together with the gain and bandwidth achievable with the common-emitter connection. A two-stage feedback circuit is analysed in detail, the behaviour being illustrated by means of flow graphs. Finally, consideration is given to the problem involved in applying large amounts of feedback over several stages and of obtaining the desired input and output impedances. A practical design is given of a 25 dB amplifier suitable for 5 telephone channels; the amplifier has 30 dB of feedback applied over three stages. A further illustrative example is also given in the design of a typical channel amplifier.

621.375.4

6233 A TRANSISTORIZED STEREO PREAMPLIFIER AND TONE CONTROL FOR MAGNETIC CARTRIDGES.
A.B.Bereskin.
I.R.E. Trans Audio, Vol. AU-8, No. 1, 17-20 (Jan.-Feb., 1960).

R.I.A.A. equalization with ±4 dB bass control and ±8dB treble control have been achieved, along with negligible hum, noise, and distortion, in a transistorized stereo preamplifier developed for use with magnetic cartridges. Simple circuit modifications adapt this preamplifier for use with most magnetic cartridges.

621.375.4 : 621.317.7

6234 TRANSISTORIZED AMPLIFIERS FOR AUTOMATIC MEASURING INSTRUMENTS.
A.A.Andreev and N.S.Nikolaenko.
Priborostroenie, 1959, No. 9. In Russian. English translation in: Instrum. Constr., 1959, No. 9, 6-8 (Sept.).

Two amplifiers are described. The a.c. amplifier is intended for automatic a.c. bridges and potentiometers, and induction instruments. It comprises an input transformer followed by five directly coupled stages and a push-pull class B output stage with a max. power output of 3.5 W. The penultimate stage is transformer coupled to the output stage which is directly coupled to the load (centre-tapped control winding of a two-phase reversible motor, $Z = 1 \times 200\ \Omega$). The overall gain is ~ 130 dB. The first five stages are fed by a semiconductor rectifier with a three-section RC filter; the output stage is fed directly by a separate rectifier without a filter. The input resistance of the amplifier is ~ 1 kΩ. The d.c. amplifier described is intended for self-balancing d.c. potentiometers and bridges. It is similar to the a.c. amplifier but includes in the input circuit a 50 c/s driven convertor of the vibrating contact type. C.F.Pizzey

621.375.4

6235 THE FREQUENCY RESPONSE OF POWER TRANSISTORS IN THE LOW-FREQUENCY RANGE AND ITS EFFECT ON THE AMPLIFICATION OF TRANSISTOR OUTPUT STAGES.
L.Hermsdorf and J.Meinhardt.
Nachrichtentechnik, Vol. 10, No. 2, 80-3 (Feb., 1960). In German.

After deriving the y and h parameters in terms of physical constants (base width, diffusion constant and lifetime) as suggested by Early, and discussing equivalent circuits, experimental values of current German power transistors are considered and compared with calculated data. The frequency characteristics of separate h parameters are discussed next, leading to tables which compare circuit characteristics of audio power transistors for the three basic configurations. The well-known frequency response advantages of common-base and -collector mode are compared with consideration of driver stage requirements, showing up the impractibility of the common-base output stage. A.Landman

621.375.4 : 621.382.2

6236 THE PHYSICAL FOUNDATIONS OF AMPLIFIERS WITH NEGATIVE MASSES. W.Drechsel.
Nachrichtentechnik, Vol. 10, No. 3, 115-22 (March, 1960). In German.

Such amplifiers have been proposed by Krömer (Abstr. 3650 of 1958). Negative masses, or negative curvature of the energy surface in k-space of a semiconductor appear at the band edges, or near re-entrant regions. It is proposed to use a d.c. electric field suitably oriented to accelerate the electrons into negative mass regions. The electron energies must be below that leading to avalanche formation or photon production. A simplified analysis of electron motion in an a.c. field shows that amplification may be obtained in a negative mass region. Collisions which might remove electrons from this region are discussed and it is concluded that a semiconductor should have low phonon- and high photon cross-section. Favourable circumstances appear to exist in Si and Ge and

some experimental data concerning these substances are used to make it plausible that the operation of a NEMAG or negative mass amplifier should be possible. Some forms which these amplifiers might take are indicated. H.Motz

621.375.4 : 621.383 : 536.3

6237 PREAMPLIFIERS FOR NON-IMAGE-FORMING INFRA-RED SYSTEMS. J.A.Jamieson.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1522-3 (Sept., 1959).

The components, circuits and construction techniques for valve and transistor preamplifiers are briefly discussed. C.Hilsum

621.375.4 : 621.383 : 536.3

6238 DETECTIVITY AND PREAMPLIFIER CONSIDERATIONS FOR INDIUM ANTIMONIDE PHOTOVOLTAIC DETECTORS. G.R.Pruett and R.L.Petritz.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1524-9 (Sept., 1959).

To obtain maximum performance from these detectors certain conditions must be fulfilled by the preamplifier. Details are given of a transistor preamplifier which can satisfy these conditions. Some experimental results are included. C.Hilsum

621.375

6239 NOISE PERFORMANCE THEORY OF ESAKI (TUNNEL) DIODE AMPLIFIERS. M.E.Hines and W.W.Anderson.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 789 (April, 1960).

For low-gain tunnel-diode amplifier stages useful low noise amplification is shown to depend not only on the noise figure of each stage but also on the stage gain. The best overall noise figure of a multistage amplifier is obtained when the ratio of load conductance to diode negative conductance is small. C.Fromberg

621.375.4

6240 DEPENDENCE OF THE POWER GAIN ON THE BAND-WIDTH IN AN INTERMEDIATE-FREQUENCY NEUTRALIZED TRANSISTOR AMPLIFIER. J.Mikula.

Slaboproudy Obzor, Vol. 21, No. 5, 268-72 (1960). In Slovak.

A grounded-emitter transistor amplifier with a tuned circuit is analysed. The coil of the tuned circuit has three tappings. The upper tapping is connected to the collector, while the lower tapping is joined to the emitter. The output signal is developed across a load G_z which is connected between the emitter and the middle tapping. A neutralizing admittance Y_n is connected between the base and the lower terminal of the coil. A formula for the maximum power gain of the amplifier is derived. By means of the formula it is shown that, for a given bandwidth, it is possible to achieve optimum matching (between the load and the amplifier) and optimum neutralization by suitably adjusting the position of the tappings. The resulting equations are used to design an amplifier operating at 1.0 Mc/s. R.S.Sidorowicz

621.375.422

6241 A LOW-DRIFT TRANSISTOR CHOPPER-TYPE D.C. AMPLIFIER WITH HIGH GAIN AND LARGE DYNAMIC RANGE. I.C.Hutcheon and D.Summers.

Proc. Instn Elect. Engrs, Paper 3227 M, publ. March, 1960. (Vol. 107 B, 451-61, 461-5).

Republication, with discussion, of the paper already abstracted as Abstr. 2344 of 1960.

621.375.9 : 539.2 : 538.27

6242 CHROMIUM-DOPED TITANIA AS A MASER MATERIAL. H.J.Gerritsen, S.E.Harrison and H.R.Lewis.

J. appl. Phys., Vol. 31, No. 9, 1566-71 (Sept., 1960).

A discussion of the paramagnetic properties of Cr^{3+} in TiO_2 is given with particular reference to tis use in solid-state masers. Energy level diagrams are included for magnetic fields in the (110), (1$\bar{1}$0), (001), and (100) planes.

621.375.9

6243 ITERATIVE TRAVELING-WAVE PARAMETRIC AMPLIFIERS. C.V.Bell and G.Wade.

I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 4-11 (March, 1960).

Presents the circuit considerations appropriate to wideband operation in a travelling-wave parametric amplifier. The model which is analysed is a transmission line periodically loaded with parametric diodes. The diodes constitute the variable elements. Across each diode is fed a large pumping voltage which produces a time-varying capacitance. A Brillouin diagram for the structure (i.e., a plot of ω versus β) can be computed from the analysis. The conditions for high gain, wide band, and other desirable characteristics are conveniently determined from this diagram. Much of the material in this paper is similar to that given in Abstr. 7366 of 1959.

621.375.9 : 538.56

6244 PARAMETRIC AMPLIFIER THEORY FOR PLASMAS AND ELECTRON BEAMS. G.S.Kino.

J. appl. Phys., Vol. 31, No. 8, 1449-58 (Aug., 1960).

A theory is given for a new type of parametric amplifier which uses a gas-discharge plasma as a nonlinear propagating medium. This theory is based on a zero-temperature plasma assumption. The nonlinear coupling between travelling waves passing through the plasma is determined by taking second-order terms in the velocity into account. A simplified normal mode theory is used to describe the effect on the propagation constants of the individual modes due to coupling between them. The theory is carried out in detail for a plasma in an infinite magnetic field and for a plasma in a zero magnetic field. The final propagation equation for the travelling waves is found in terms of the fields in the plasma of the small-signal pumping wave, signal wave, and idler wave. The theory is extended to cover the case of beam-type parametric amplifiers. It is shown that the theory is applicable both to beam-type amplifiers which use space-charge waves for all three modes of propagation or to waves which are partially those of a circuit and of the beam itself. The results obtained are in agreement with the theory of Pouisell and Quate for the principal waves of a space-charge wave parametric amplifier.

621.375.9

6245 SPACE-CHARGE WAVE PARAMETRIC AMPLIFIERS. J.S.Cook, W.H.Louisell and C.F.Quate.

J. Electronics and Control, Vol. 8, No. 1, 1-18 (Jan., 1960).

An electron beam which is velocity modulated in the form of a fast space-charge mode at frequency ω, called the pump frequency, will parametrically amplify a signal at frequency ω_1 which is applied to the beam in the form of a fast space-charge wave at ω_1. However, due to the nonlinear nature of the beam, idler frequencies $l\omega + m\omega_1$ (where l and m are zero or positive or negative integers) will be generated on the beam. Although in principle fast mode noise can be removed from the beam, it would be extremely awkward to attempt removal at very many of these idler frequencies. Experimental and theoretical studies indicate that noise from these higher idlers will prove serious. Accordingly, it is proposed to couple the signal and pump to the beam by means of a slow wave structure with certain peculiar characteristics. The pump mode is taken as the travelling-wave tube normal mode which is now growing, y_3 in Pierce's notation. By varying u_0, the d.c. beam velocity, the phase velocity of the pump mode on the beam can be varied. By choosing the phase velocity of the pump mode on the beam and helix to be synchronous with the phase velocity of the signal mode on the uncoupled helix and also synchronous with the uncoupled phase velocity of the fast signal mode on the beam, it is found that noise from all higher idler frequencies is periodically transferred between the beam and helix although it grows exponentially. Similarly, the signal on the helix is periodically transferred from the helix to the beam and grows exponentially. However, at the position at which all the noise has been transferred back to the beam, all the signal has been transferred back to the helix. So the noise does not have to be removed from the beam. The choice of synchronous velocities assures that each time an extra pair of idler frequencies is added to the system, two growing modes are introduced which grow at the same rate but travel with different phase velocities. These modes interfere with each other and cause standing waves to be set up so that there are periodic noise nulls on the helix where the signal is at its maximum. All of the analysis assumes large QC at all frequencies which couple to the helix so that slow-mode noise can be neglected. A general theory is presented which considers the effect of pump harmonics and higher idler frequencies when two or more are allowed to couple to a circuit.

621.375.9

6246 LOW-NOISE PARAMETRIC AMPLIFIER. R.C.Knechtli and R.D.Weglein.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1218-26 (July, 1960).

The theory of the parametric amplifier has been reformulated to permit the prediction of noise temperature and pump power in terms of the physical parameters of the nonlinear element and circuit. The results of this analysis are supported by careful experiments at S-band using a gold-bonded germanium semiconductor diode. They can be summarized as follows: – (1) performance of a parametric amplifier using semiconductor diodes with respect to noise temperature and pump power can be accurately predicted, once the diode and circuit parameters have been measured: (2) it is shown that the ultimate limitation on noise temperature depends

simply on the product of the diode cutoff frequency and the normalized capacitance swing: (3) the derived figure of merit for the diode can serve as a basis for optimum design of the semiconductor parameters.

621.375.9

6247 THEORY OF SINGLE-RESONANCE PARAMETRIC AMPLIFIERS. S.T.Fisher.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1227-32 (July, 1960).

A parametric amplifier that supports a resonance at the idler frequency only is capable of unlimited gain when operated either as a straight-through amplifier or as a lower-sideband up-convertor. In the latter case, the idler frequency becomes the output frequency. The analysis of the single-resonance parametric amplifier consists of determining the stability criteria and power gains associated with a nonlinear capacitance that is incorporated in a network producing a resonance at the idler frequency but not at the signal frequency. The admittance matrix of the network is first established; and then from this matrix the input admittances and the power-gain expressions for straight-through amplification and lower-sideband up-conversion are derived. The single-resonance parametric amplifier, as contrasted with one which is tuned at both the signal frequency and the idler frequency, is, in principle, easy to adjust because there is only one resonance. For this reason, the feasibility of continuously tunable parametric receivers becomes immediately evident.

621.375.9

6248 UNIDIRECTIONAL PARAMAGNETIC AMPLIFIER DESIGN. M.W.P.Strandberg.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1307-20 (July, 1960).

The r.f. parameters and the quantum-mechanical parameters entering into the design of paramagnetic quantum-mechanical amplifiers are described and discussed. The physical and electrical limitations on such parameters as gain–bandwidth product, gain stability, and nonreciprocity are described analytically and with design curves. Two realizations of nonreciprocal amplifiers are described and discussed. In particular, operation of a nonreciprocal amplifier at 9 Gc/s is described. Explanations for the observed properties of previously reported amplifiers are given, and the steps necessary to achieve high gain–bandwidth product and nonreciprocity with paramagnetic amplifiers are described.

621.375.9

6249 PARAMETRIC AMPLIFICATION, POWER CONTROL, AND FREQUENCY MULTIPLICATION AT MICROWAVE FREQUENCIES USING CYCLOTRON-FREQUENCY DEVICES. C.L.Cuccia.

R.C.A. Rev., Vol. 21, No. 2, 228-44 (June, 1960).

If an electron beam is projected through an axial magnetic field and acted upon by a transverse alternating-current electric field having a frequency approximately equal to the characteristic cyclotron frequency of the magnetic field, a rope-like bunch of electrons will circulate about the beam axis with the cyclotron angular frequency. This electron bunch will have a radius of angular motion corresponding to the power absorbed from the transverse field. Power control, frequency multiplication, and low-noise amplification can be achieved by passing the bunched circulating beam through appropriate structures. Basic structures for providing these functions and their principles of operation are described.

621.375.9

6250 NOTE ON THE NOISE FIGURE OF NEGATIVE CONDUCTANCE AMPLIFIERS. A.van der Ziel and J.Tamiya.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 796 (April, 1960).

A discussion of the effect on the noise figure of a negative conductance amplifier of (a) coupling it directly to the receiver and (b) coupling it to the receiver via an ideal step-down transformer of suitably chosen turns ratio — eliminating the use of a circulator in either case. The criteria that the noise figure shall not be increased by the omission of the circulator are derived. It is concluded that the tunnel diode is more likely to satisfy the criteria than the parametric amplifier in view of its lower impedance.

G.D.Sims

621.375.9

6251 HARMONIC GENERATION USING IDLING CIRCUITS. I.Kaufman and D.Douthett.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 790-1 (April, 1960).

The power generated at a given harmonic frequency with a given order of non-linearity may be increased by the addition of idling circuits resonant at chosen intermediate harmonic values. Resistive rather than reactive termination at these frequencies allows a larger circulation of energy and thereby increases the order of harmonic that can be usefully generated.

G.D.Sims

621.375.9 : 539.2 : 537.311

6252 ON THE QUESTION OF NEW POSSIBILITIES OF AMPLIFICATION BY THE MOVEMENT OF CARRIERS IN SEMICONDUCTORS. E.Groschwitz.

Z. angew. Phys., Vol. 12, No. 8, 370-82 (Aug., 1960). In German.

Methods are considered in a general way, by which amplification might be achieved using charge carriers of negative effective mass.

J.Franks

MODULATION . DEMODULATION

621.376 : 621.374.3

6253 PERIODIC STATES IN SYSTEMS WITH NON-LINEAR PULSE ELEMENTS. M.M.Simkin.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 6, 1323-6 (April 21, 1960). In Russian.

A train z(t) of amplitude-, width- or position-modulated pulses is applied to the input of the linear part of the system, the pulses being displaced non-linearly with respect to the discrete values of the pulse-element input signal $u(t) = u[n]$. The periodic states are defined in accordance with the first harmonic, their frequencies being connected with the repitition frequency of the pulse element $\omega_0 = 2\pi/T_0$ by the condition $N = \omega_0/\omega_1 = 2\pi/\bar{\omega}_1 \geq 2$, integer. The periodic states of this type are evaluated approximately for any type of pulse modulation and of non-linearity in the element.

D.E.Brown

621.376

6254 A CONTRIBUTION TO THE THEORY OF THE TRANSMISSION OF AMPLITUDE-, FREQUENCY-, OR AMPLITUDE- AND FREQUENCY-MODULATED CARRIERS IN LINEAR SYSTEMS. E.Augustin.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 6, 177-85 (Jan., 1960). In German.

A non-converging Taylor expansion of the p transform of the transfer function, which has been used for the calculation of distortion, is applied to an amplifier with a single damped tuned circuit. It is shown that, for frequency-modulated signals, the errors introduced by neglecting higher order terms set a severe limit on the range of frequency deviation and phase shift for which the method is valid. For multistage amplifiers the restriction is even more severe.

W.G.Stripp

621.376.2 : 621-526

6255 TRANSFER FUNCTION OF THE CHOPPER MODULATOR. T.Numakura, Z.Abe and T.Kinugawa.

E.T.J. Japan, Vol. 5, No. 2, 74-8 (1959).

An attempt is made to produce an expression which is sufficiently simple to permit an assessment of the effect of changes in the parameters on the overall transfer function. Since a two-phase servo-motor is assumed to act as a demodulator higher harmonics are neglected. A balanced type of modulator with transformer input and an unbalanced one with an RC network are considered.

T.Horrocks

621.376.22

6256 PROPERTIES AND DIMENSIONS OF RING MODULATORS. I. H.Biey.

Nachrichtentech. Z. (N.T.Z.), Vol. 13, No. 3, 129-36 (March, 1960). In German.

Quasi-linear theory is applied for performance prediction of ring modulators. All relevant quantities required for the formulation of component dimensions are included, such as transfer loss, characteristic impedance, input impedance and decrement: terminal impedances can take a series of complex values (filter). The theory is developed to the point where correspondence of prediction and measurement and also graphical representation of functional relations is possible. Results of this work can be sensibly applied to other quasi-linear circuits.

A.Reiss

621.376.22

6257 A CORRELATOR EMPLOYING HALL MULTIPLIERS APPLIED TO THE ANALYSIS OF VOCODER CONTROL SIGNALS. A.R.Billings and D.J.Lloyd.

Proc. Instn Elect. Engrs, Paper 3295 E, publ. Sept., 1960 (Vol. 107 B, 435-8).

After an initial discussion of short-term correlation functions the design and performance of an auto- and cross-correlator using Hall-effect multipliers are described. It is shown that these devices are well suited to act as the multiplying elements and as modulators in associated circuits, provided that one of the time-functions to be multiplied has a narrow bandwidth. Examples of measured auto- and cross-correlation functions are given for sine waves and noise and for the control signals of a vocoder, from which interesting conclusions can be drawn about the redundancy of vocoder signals.

621.376.232 : 621.397.132

6258 APPLICATION OF SYNCHRONOUS DETECTORS IN COLOUR TELEVISION. Z.Hajoš.

Slaboproudy Obzor, Vol. 21, No. 5, 273-7 (1960). In Slovak.

It is shown that a synchronous detector in which a resistive component is modulated by the carrier frequency can be used to detect the envelope of an amplitude-modulated signal with a suppressed carrier frequency. Two such detectors operating with a 90° shift can be employed to detect the two components of the colour signal in television. The detectors may be based on pentodes or heptodes, the colour signal being applied to the first control grid and the demodulating signal to the other control grid. Triodes may also be used as the detectors. In this case the colour signal is applied to the grid or anode and the demodulating voltage is fed to the cathode or grid. The demodulation characteristics of pentodes, heptodes and triodes are given. It is concluded that the triode detector with anode signal input and grid demodulation input is the most satisfactory (mainly because of its simplicity).

R.S.Sidorowicz

621.376.232.2

6259 CALCULATION OF DIODE DETECTOR PERFORMANCE. G.I.Levitan.

Radiotekhnika, Vol. 15, No. 6, 22-23 (June, 1960). In Russian.

The usual approximate formulae for the performance of the thermionic diode detector are based on a straight-line characteristic passing through the origin. The characteristic is here considered to intersect the voltage axis at some negative voltage, and resulting modifications to the performance formulae are investigated.

F.Quelon

621.376.3

6260 ENERGY SPECTRA OF F.M. SYSTEM WITH LOW BETA, HIGH DEVIATION RATIO, AND M.F. WHICH APPROACHES CARRIER FREQUENCY. S.L.Simmons.

I.R.E. Trans Space Electronics and Telemetry, Vol. SET-6, No. 1, 17-19 (March, 1960).

621.376.32

6261 THE ANODE-MODULATED GROUNDED-GRID STAGE. B.P.Terent'ev.

Radiotekhnika, Vol. 15, No. 3, 31-4 (March, 1960). In Russian.

The fundamental feature of this stage is that the oscillatory voltage across the tuned circuit is equal to the sum of the voltages on the anode and grid. As a result of this the fundamental of the anode current is proportional not only to the anode voltage but to the sum of the anode and grid voltages. Since under some circumstances the anode voltage may actually fall below the grid voltage the characteristic takes on a number of particular forms. It is shown graphically and by means of oscillograms that the slope of the modulation characteristic may be expected to change sign. Optimum working conditions are deduced and it is concluded that the best grid bias is between 10% and 20% of the maximum grid voltage and that modulation depth should be between 70% and 80%. S.C.Dunn

621.376.5 : 621.398

VERSATILE P.A.M./P.D.M. DECOMMUTATION STATION. See Abstr. 6524

621.376.55

6262 MICROMINIATURE MULTICHANNEL PULSE-POSITION-MODULATION SYSTEM INCORPORATING TRANSISTOR-MAGNETIC-CORE CIRCUITRY. H.Kihn, R.J.Klensch and A.H.Simon.

R.C.A. Rev., Vol. 21, No. 2, 199-227 (June, 1960).

An experimental five-channel time-division multiplex system has been built incorporating a microminiature transistor–core ring counter for both the transmitter modulator and receiver sampler. The pulse-position modulation of the transmitter modulator results from the variable time triggering of a transistor–core pulse generator by the variation of either the transistor input voltage or ferrite-core coercive-force thresholds. The sampling rate used in the system is 15 kc/s with an upper limit set only by the transistor and core high-frequency cutoff. Channel cross-talk as low as −40 dB may be obtained by suitable adjustment of operating parameters. Increased isolation can be obtained by reduction of repetition rate and use of a faster transistor such as the 2N 139 or equivalent. Power consumption is approximately 200 mW at the 15 kc/s rate. Linearity is adequate (of the order of several per cent) for voice communication, but could be improved by optimization of drive and by trigger-current shaping to compensate for hysteresis-loop curvature.

ELECTRONICS

SEMICONDUCTOR MATERIALS AND DEVICES

TRANSISTORS

621.382

6263 SKIN EFFECT IN SEMICONDUCTORS. A.H.Frei and M.J.O.Strutt.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1272-7 (July, 1960).

Deals with the theory of skin effect in semiconductor materials including the effect of displacement currents, which are generally neglected in the skin-effect theory for metallic conductors. In the case of flat plates, formulae are derived for the field distribution, impedance and eddy-current power losses, considering symmetrical electric as well as magnetic fields. Impedance as a function of frequency is measured for germanium in the microwave cm-range. The measured values agree with the theoretical results. The equivalent depth of penetration is calculated and compared with the skin depth for metals. All theoretical results are represented in graphs for different values of the ratio γ, i.e., the displacement current divided by the conduction current. The formulae are extended to the case of complex permeability, corresponding to hysteresis.

621.382 : 537.311 : 539.2

6264 SPREADING RESISTANCE IN CYLINDRICAL SEMICONDUCTOR DEVICES. D.P.Kennedy.

J. appl. Phys., Vol. 31, No. 8, 1490-7 (Aug., 1960).

For cylindrical semiconductor components, computation of spreading resistance is considered a boundary value problem of the solid circular cylinder. Solutions of this problem may be used, for example, to characterize the thermal spreading resistance within the package of a semiconductor device, the electrical spreading resistance in a mesa-type parametric diode, and the extrinsic collector resistance of a mesa transistor. Equations describing the thermal (or electrical) spreading resistance are presented in graphical form for a range of geometrical parameters applicable to many practical situations. Further, examples are given for the potential distribution within each cylindrical structure considered in this analysis.

621.382.032.27 : 539.2 : 537.311

6265 CURRENT NOISE DUE TO OHMIC CONTACTS ON CADMIUM SULFIDE. J.J.Brophy and R.J.Robinson.

J. appl. Phys., Vol. 31, No. 8, 1343-4 (Aug., 1960).

Current noise measurements on the same lightly doped cadmium sulphide crystal having indium soldered contacts of different quality

are used to demonstrate the strong influence of contacts on the observed noise spectra. The results suggest the presence of shallow trapping states distributed in energy and located near the electrodes. The concentration of these states depends on the quality of the contact. These effects are not contact noise in the usual sense since the shape of the noise spectra is only moderately affected; however, the noise level may change by orders of magnitude.

621.382.2

6266 SEMICONDUCTOR DIODES OPERATED IN THE RANGE OF BREAKDOWN OF THE VOLTAGE–CURRENT CHARACTERISTIC IN ORDER TO RAISE THE SPEED OF ACTION OF PULSE CIRCUITS. Yu.R.Nosov.
Priborostroenie, 1959, No. 9. In Russian. English translation in: Instrum. Constr., 1959, No. 9, 14-16 (Sept.).

A brief outline is given of the principles of reversed biased diodes used in switching circuits where the diode is switched about the Zener point. J.MacCormack

621.382.2 : 539.2 : 537.311

6267 ON THE CURRENT RATIO I MAX/I MIN OF TUNNEL DIODES. M.Michelitsch.
Naturwissenschaften, Vol. 47, No. 12, 247 (1960). In German.

The peak–valley current ratio is found to be very dependent on the time taken to alloy the junction. C.Fromberg

621.382.2 : 539.2 : 537.311

6268 DETERMINATION OF THE IMPURITY DISTRIBUTION IN JUNCTION DIODES FROM CAPACITANCE–VOLTAGE MEASUREMENTS. J.Hilibrand and R.D.Gold.
R.C.A. Rev., Vol. 21, No. 2, 245-52 (June, 1960).

To be useful, the impurity density level should be accurate to better than 20% and the impurity profile should be even more accurate. A method for the measurement of impurity distributions to the required degree of accuracy is described.

621.382.2 : 621.375.4

THE PHYSICAL FOUNDATIONS OF AMPLIFIERS WITH NEGATIVE MASSES. See Abstr. 6236

621.382.2 : 621.396.662.2

INDUCTIVE ELEMENTS FOR SOLID-STATE CIRCUITS. See Abstr. 5782

621.382.21

6269 GALLIUM ARSENIDE MICROWAVE DIODE AT X BAND. M.Herndon and A.C.MacPherson.
Proc. Inst. Radio Engrs, Vol. 48, No. 5, 945 (May, 1960).

Measurements have been made at 9375 Mc/s on point-contact GaAs diodes which compare favourably with germanium and silicon diodes. The best had a conversion loss of 5.6 dB and a noise temperature ratio of 1.14. They are less bias-sensitive than Ge diodes, and should be suitable for high temperature operation. C.Fromberg

621.382.22 : 539.2 : 537.311

6270 THE EFFECT OF HEAT TREATMENT AND ION BOMBARDMENT ON THE PROPERTIES OF SILICON POINT-CONTACT DIODES. I.D.Kirvalidze and S.G.Chernyavskaya.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 155-8 (1959). In Russian.

Both heat treatment in air (10 hours at 1250°C) and ion bombardment (7 hours) in a glow discharge in argon improved at least one of the following characteristics of p-type diodes: breakdown voltage, forward resistance, reverse resistance. The improved properties of p-type diodes were retained up to 400°C. No improvement was produced by the glow-discharge treatment in the case of n-type diodes. A.Tybulewicz

621.382.22 : 539.2 : 537.311

6271 POINT-CONTACT GALLIUM ARSENIDE DIODES. D.N.Nasledov, N.N.Smirnova and B.V.Tsarenkov.
Fiz. tverdogo Tela, Sbornik [Supplement] II, 96-8 (1959). In Russian.

Describes preparation of point-contact diodes made of n-GaAs. Gives current–voltage characteristics at temperatures from 25 to 300°C and shows that rectifying properties are retained up to 300°C. A.Tybulewicz

621.382.23 : 539.2 : 537.311

6272 INVESTIGATION OF CHARACTERISTICS OF GERMANIUM DIODES.
I.M.Senderikhin and P.V.Sharavskii.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1497-1505 (July, 1960). In Russian.

Reports a study of static and pulse voltage–current characteristics and of thermal breakdown of germanium thermistors and rectifiers. See also following abstract. A.Tybulewicz

621.382.23 : 539.2 : 537.311

6273 THEORY OF THE THERMAL BREAKDOWN OF GERMANIUM DIODES. I.M.Senderikhin.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1506-17 (July, 1960). In Russian.

Inverse voltage–current characteristics of germanium point-contact and junction diodes are discussed within the framework of the thermal breakdown theory. A qualitative agreement is reported between the experimental results (see preceding abstract) and theory in the case of an impurity semiconductor. A.Tybulewicz

621.382.233

6274 AN INVESTIGATION OF THE DYNAMIC SWITCHING PROPERTIES OF 4-LAYER DIODES.
G.E.McDuffie, Jr and W.L.Chadwell.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 50-3 (1960) = Commun. and Electronics, No. 47 (March, 1960).

The fall of breakover voltage with increase in the rate of rise of bias voltage is discussed in terms of the capacitive current surges through the junction capacitances. The opposite trend at high repetition frequencies is explained by the finite rate of discharge of the capacitances. F.F.Roberts

621.382.3

6275 RADIATION DAMAGE AND TRANSISTOR LIFE IN SATELLITES. J.M.Denney and D.Pomeroy.
Proc. Inst. Radio Engrs, Vol. 48, No. 5, 950-2 (May, 1960).

The Fredon and White proton-energy spectrum (S.C.Fredon and R.S.White "Protons in the Earth's Magnetic Field" UCRL-5581-T May, 1959: to be published in Phys. Rev. Letters) has been employed as the basis for estimating the rate of atomic displacements produced in silicon and germanium transistors during exposure to the earth's inner charged particle belt. The total number of displacements per target atom assuming a 12.5 eV displacement energy at a height of 1200 km is 2000 proton^{-1} cm^{-2} and 4000 proton^{-1} cm^{-2} for silicon and germanium respectively. The corresponding displacement rates are 2.6×10^6 cm^{-3} sec^{-1} and 5.1×10^6 cm^{-3} sec^{-1} for silicon and germanium. The life time of transistors exposed in the inner equatorial (±25°) radiation belt as a function of altitude is estimated using the flux–altitude relationship by Van Allen and assuming that the Fredon and White energy spectrum is altitude independent. The results are given as a graph of lifetime versus altitude. J.MacCormack

621.382.3 : 628.972

THE APPLICATION OF TRANSISTOR UNITS TO LIGHTING IN VEHICLES. See Abstr. 5568

621.382.3 : 621.375.4

EQUIVALENT CIRCUITS FOR TRANSISTORS DRIVEN AS LINEAR AMPLIFIERS. See Abstr. 6229-31.

621.382.333 : 621.385.44

APPLICATION OF TRANSISTORS TO LONG DISTANCE TELEPHONY. See Abstr. 5748

621.382.333 : 539.2 : 537.311

6276 ELECTRIC FIELD IN THE BASE OF A JUNCTION TRANSISTOR AT LOW INJECTION LEVELS.
Yu.S.Ryabinkin.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 159-69 (1959).
In Russian.

An expression was obtained for the electric field distribution in the quasi-neutral region in the base of a junction transistor at low injection levels. Solution of the fundamental equations of the transistor theory was discussed for various relationships between diffusion, recombination and the field. The region of applicability of the diffusion–recombination theory of Shockley was found. Dependence of the emitter–collector transmission factor on the emitter current was found to agree well with experiment at low injection levels. It was found that in high-frequency transistors the effect of the field dominates the effect of recombination even at low

injections levels. An expression was found for the current–voltage characteristics and for the distribution of minority carriers in the base of the transistor.

621.382.333

6277 ON THE APPLICATION OF THE BASE CHARGE CONCEPT TO THE DESIGN OF TRANSISTOR SWITCHING CIRCUITS. R.S.C.Cobbold.
I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 12-18 (March, 1960).

Describes a new method of measuring the effective decay time of excess minority carriers in the base of junction transistors, the results of which show an approximately exponential decay with time. The relation between the decay-time constant and the normal and inverse transistor parameters is discussed, and it is shown how the experimental measurements can be directly applied to the design of transistor pulse circuits. Using the Ebers and Moll equivalent circuit for a saturated transistor, an analysis is made of the effect on the charge storage caused by the passage of a collector current when the base connection is open circuit. The case of a transient collector current is also examined, and it is concluded that for typical alloy junction transistors the passage of a collector current plays little part in determining the charge storage. Thus, the storage time with open-circuit base is determined by the initial excess charge, the collector current existing when the transistor enters the active region, and the decay time constant for minority carriers. A simple equivalent circuit for determining the decay of stored charge when a reverse base current is applied is also discussed.

621.382.333

6278 CONTACTLESS POLARIZED RELAY USING TRANSISTORS. S.V.Kulikov.
Priborstroeine, 1959, No. 9. In Russian. English translation in: Instrum. Constr., 1959, No. 9, 8-11 (Sept.).

The polarized relay circuit using tansistors [Meissner, Elektronik, No. 4, 105-6 (1957)] has a threshold sensitivity of 35 mW. A development of this circuit is described and it is claimed that the sensitivity has been increased by several orders of magnitude. The dead zone has been reduced to a very small fraction of the operating range and temperature stability is improved using Russian silicon transistors. It is claimed that non-linear feedback has produced an ideal relay characteristic. J.MacCormack

621.382.333

6279 AVALANCHE CARRIER MULTIPLICATION IN JUNCTION TRANSISTORS AND ITS IMPLICATIONS IN CIRCUIT DESIGN. M.L.N.Forrest.
J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 429-39 (June, 1960).

Theories of junction breakdown and transistor action necessary to account for the observed characteristics of avalanche carrier multiplication are surveyed. The implications of these characteristics in circuit design are discussed and certain special techniques for avoidance of anomalous operation in conventional circuits are described. Avalanche multiplication may be used to obtain useful device characteristics and circuits for exploitation of these are surveyed. Methods of measurement of avalanche characteristics are outlined.

621.382.333

6280 A HYBRID π EQUIVALENT CIRCUIT OF A TRANSISTOR AND FREQUENCY DEPENDENCE OF Y-PARAMETERS. V.K.Labutin.
Radiotekhnika, Vol. 15, No. 5, 33-8 (May, 1960). In Russian.

Exact formulae for y_{11}, y_{12}, y_{21} and y_{22} are derived, and their dependence on frequency can be generally expressed by

$$y_{kl} = g_{kl_0} \frac{1 + (f/f_i)^2}{1 + (f/f_j)^2} + i\omega\, C_{kl_0} \frac{1 + (f/f_i)^2}{1 + (f/f_k)^2}$$

where k and l can be 1 or 2; i and j indicate characteristic frequencies for a given parameter, 0 refers to low frequency and 1 to cut-off frequency. To apply the above formula generally, knowledge of 4 conductances (g_{11_0}, g_{12_0}, g_{21_0}, g_{22_0}), 4 capacitances (C_{11_0} etc) at low frequency and 5 frequencies (f_i and frequency pertaining to g_{11}, g_{12}, g_{22}) is required. Simplified expressions are then derived and used to construct normalized families of curves for rapid evaluation of various parameter changes with frequency. A.Landman

621.382.333.3 : 621.314.63

DESIGN OF CONTROLLED RECTIFIERS USING TRIODE TRANSISTORS. See Abstr. 5996

PHOTOELECTRIC DEVICES

621.383 : 536.3

6281 THE BEHAVIOR OF INFRARED DETECTION ELEMENTS UNDER NUCLEAR RADIATION EXPOSURE. E.W.Kutzscher.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1520-1 (Sept., 1959).

Infrared detectors were bombarded with neutrons and γ radiation. PbS, PbTe and InSb photocells showed no change in properties when γ radiation at a strength of 20 000 r/hr was incident, but gold-doped germanium photoconductive cells showed a considerable increase in noise level during the exposure. Similar results were obtained for neutron bombardment. In PbS cells exposed to doses of more than 10^7 r, changes occurred which lasted for one month after exposure. C.Hilsum

621.383 : 537.533

6282 ABSOLUTE SPECTRAL RESPONSE CHARACTERISTICS OF PHOTOSENSITIVE DEVICES. R.W.Engstrom.
R.C.A. Rev., Vol. 21, No. 2, 184-90 (June, 1960).

Data are presented comparing absolute response characteristics associated with the various commercial-type photocathodes. A table is provided of luminous sensitivity, dark emission, and quantum efficiency typical of these photocathodes. Some similar data are presented for photoconductive devices.

621.383 : 621.375.1 : 538.56

PREAMPLIFIERS FOR NON-IMAGE-FORMING INFRARED SYSTEMS. See Abstr. 6237

621.383.2 : 621.32

6283 PHOSPHORS FOR ELECTROLUMINESCENT LAMPS. L.W.Strock.
Illum. Engng, Vol. 55, No. 1, 24-31 (Jan., 1960).

Cubic and hexagonal forms of ZnS can be represented by different stacking of alternate layers of Zn and S atoms, with three- and two-layer periodicity respectively. It is explained by diagrams how various disordered forms, recognisable by X-rays or polarized light, can be produced by shifts of these layers. Single atom displacements are also described, and these are considered to be responsible for electroluminescence, though stacking disorders may occur as well. In the discussion the author's conclusions are contested. S.T.Henderson

621.383.8

6284 LIMITATIONS AND POSSIBILITIES FOR IMPROVEMENT OF PHOTOVOLTAIC SOLAR ENERGY CONVERTERS. I. CONSIDERATIONS FOR EARTH'S SURFACE OPERATION. M.Wolf.
Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1246-63 (July, 1960).

Seven factors limiting the performance of photovoltaic solar energy convertors are listed and explained. They can be classified into basic and technology determined limitations. Possibilities for improvement on technology determined limitations are investigated for the silicon solar cell. Such possibilities are: heavier p-layer doping; change of geometry, possibly by application of grid structures; improvement of the material constants; and utilization of drift fields for improved collection. Materials other than silicon are discussed with regard to their potential for better performance than that obtainable from the silicon solar cell together with new methods of approach, such as the multilayer and the multiple transition solar cell. Both of these methods yield theoretically large improvements, but realization depends on further advances in compound semiconductor technology and in knowledge about localized centres in the forbidden gap. Limit conversion efficiencies of 38.2% for a 3-layer cell and of 51% for a 3-transition cell, compared to 23.6% for a single p–n junction, single transition cell, are obtained. Also discussed are the possible merits of the application of the graded energy gap to photovoltaic energy convertors, and potential improvement in collection efficiency is found for certain cases.

621.383.8 : 537.3

6285 INFRARED DETECTOR SILICON SOLAR CELL POWER SUPPLY. L.W.Schmidt and J.I.Davis.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1519-20 (Sept., 1959).

Silicon cells may be used to provide a voltage bias for a photoconductive detector, or the power supply for the signal amplifier. C.Hilsum

PARTICLE ACCELERATORS

621.384.611 : 537.54

6286 VARIABLE ENERGY SPIRAL RIDGE CYCLOTRON. J.S.Allen, S.Chatterjee, L.E.Ernest and A.I.Yavin.
Rev. sci. Instrum., Vol. 31, No. 8, 813–22 (Aug., 1960).

A spiral ridge cyclotron which can accelerate protons from 3.5 to 15 MeV, deuterons from 7 to 14 MeV, $(He^3)^{++}$ from 11 to 37 MeV, and α-particles from 15 to 27 MeV is described. The required magnetic field is obtained from four spiral shims and five correction coils placed on each of the pole faces of the magnet. The spiral shims produce a maximum r.m.s. flutter of 0.07 which provides sufficient vertical focusing beyond a radial distance 6 in. from the centre of the cyclotron. The two innermost correction coils provide magnetic focusing up to 6 in. and the three outer coils build up the isochronous field. Focusing effects of slits, placed on the dee and the dummy dee in the path of the particles for the first four revolutions, are demonstrated. The machine can deliver 1 mA of proton beam at the extraction radius, 18.5 in.

621.384.612 : 537.54

6287 PHASE OSCILLATIONS IN HIGH CURRENT SYNCHROTRONS. I.G.Henry.
J. appl. Phys., Vol. 31, No. 8, 1338–42 (Aug., 1960).

The theory of phase oscillations in the synchrotron, first given by Bohm and Foldy (Abstr. 469 of 1947), is extended to cover the case where the amplitude of the accelerating voltage is not constant and where the accelerated bunch is itself sufficiently large to produce an appreciable part of the accelerating voltage. It is found that the phase oscillation is more stable when the driving frequency is less than the natural frequency of the accelerating electrode system, and that the anode characteristic of the driving amplifier has a negligible effect on the phase stability.

ELECTRON TUBES

621.385.032.213.13 : 537.534

6288 EMISSION OF NEGATIVE IONS OF OXYGEN DURING THE ACTIVATION OF OXIDE-COATED CATHODES. N.A.Surplice.
Brit. J. appl. Phys., Vol. 11, No. 9, 430–3 (Sept., 1960).

Oxide-coated cathodes have been used as ion sources in a simple mass spectrometer and have been found to emit atomic negative ions of oxygen during their activation at high temperatures (1150–1275°K). A retarding potential at the collector was used to separate the ions emitted by the cathode from the ions formed in the residual gas. Most of the oxygen ions from the cathode arrived at the collector with more energy than they could have obtained from the potential difference across the electron gun, and their number increased as the cathode became more active. The evidence suggests that the ions were formed by dissociation of the oxide coating, then diffused to the surface and were removed by positive ion bombardment. Such a process would leave oxygen vacancies in the oxide which would act as electron donors and increase its electron emission.

621.385.032.213.13

6289 DIFFUSION OF Ba IN SrO LAYER DEPOSITED ON OXIDE-COATED CATHODE. S.Nakamura.
J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 4, 561–7 (April, 1960). In Japanese.

The surface structure and activity of the normal type of (BaSr)O cathode, which is covered with a SrO-rich layer in the operating condition, are equivalent to those of a SrO film deposited on a BaO cathode, but the activity of such composite cathodes is low before activation, the activity increasing when the cathodes are kept at a constant high temperature, as with the (BaSr)O cathode. The activation rate is found to agree with the theoretical curve, assuming that the Ba in the BaO coating is diffused into the deposited SrO film and the diffusion coefficient is given by the relation $D = D_0\exp(-E/kT)$. Experimental results show that the activation energy E for diffusion of Ba into the SrO layer is 0.75 eV, and the mean value of D_0 is 4×10^{-8} cm^2/sec. An explanation is given of the reason why the exporated film of SrO on BaO cathode has high activity similar to that of the (BaSr)O cathode. A.Wilkinson

621.385.032.213.13

6290 A LOW-WATTAGE PLANAR CATHODE. T.N.Chin.
R.C.A. Rev., Vol. 21, No. 2, 191–8 (June, 1960).

A new type of cathode assembly developed for use in electron-beam tubes, such as camera tubes, kinescopes and travelling-wave tubes is described, and a brief record of its development is given. The thermal losses in a cathode structure are analysed. Both analytical and experimental evidence indicates that the conduction loss dominates over the radiation loss in oxide-coated cathodes. For a 6.3 V heater, 0.6 W of power input is adequate to maintain the emitting surface of the new type cathode at a temperature of 1050°K, as against 4 W for a similar cathode of conventional construction.

621.385.032.213.13 : 537.533

6291 NONLINEAR EFFECT UPON THE EQUIVALENT CIRCUIT OF INTERFACE IMPEDANCE IN PULSE METHODS. J.Tamiya.
Rev. sci. Instrum., Vol. 31, No. 7, 786–8 (July, 1960).

Shows that the non-linear characteristic of the test diode introduces spurious RC-elements into the equivalent circuit. Therefore, for a layer with multiple time constants the "apparent" RC-elements differ from the true ones. A.H.W.Beck

621.385.1 : 537.533

6292 PASSAGE OF CURRENT THROUGH THE GLASS ENVELOPE OF A RECEIVING-TYPE VALVE. H.N.Daglish.
Brit. J. appl. Phys., Vol. 11, No. 9, 440–5 (Sept., 1960).

In normal operation of receiving-type valves, with soda glass envelopes, a small current may flow through the glass to an external coating. Part of this current consists of positive ions generated by the flow of electrons through the atmosphere inside the envelope. As the pressure inside the valve falls during operation, the value of the ratio of the current through the envelope to the anode current flowing in the valve also falls, eventually reaching a stable value which is independent of pressure. This residual value is due to the emission of photoelectrons from the inside of the glass, when bombarded by X-rays generated at the anode. It therefore depends upon the nature of the anode surface and upon the anode potential. The continuous passage of this photoelectric current through the glass may generate small quantities of gas by electrolysis, and so affect the behaviour of the valve. Experimental evidence suggests that the risk of permanent damage to the cathode emission is very small.

621.385.1

6293 THE [UNWANTED] PRODUCTION OF X-RAYS IN [THERMIONIC AND CATHODE-RAY] TUBES. W.Reusse.
Nachrichtentech. Z. (N.T.Z.), Vol. 13, No. 2, 53–7 (Feb., 1960). In German.

At voltages below 5 kV (e.g. domestic television c.r. tubes) the generation of X-rays is negligible. At higher voltages it can be a serious hazard and figures are given for the radiation intensities in the neighbourhood of h.t. rectifiers, t.v. projection tubes, radio valves, magnetrons and thyratrons at the voltages commonly used in practice. F.T.Farmer

621.385.1.032 : 537.533

6294 NEGATIVE GLOW PLASMA AS A CATHODE FOR ELECTRON TUBES. J.M.Anderson and L.A.Harris.
J. appl. Phys., Vol. 31, No. 8, 1463–8 (Aug., 1960).

The plasmas of the negative glow region of a cold-cathode discharge in helium and neon are examined for their ability to supply free electrons for operation of a "vacuum" amplifier tube. The plasma replaces the conventional oxide-coated hot cathode in a tube with closely-spaced fine-mesh grids. At gas pressures ~1 mm Hg the VA characteristics of the amplifier portion of the total discharge tube are essentially the same as found in the high-vacuum, hot-cathode counterpart. The noise content of the anode-current of the "glow-cathode" tube, defined by equivalent noise-diode current, was examined from 50 kc/s to 50 Mc/s. At the lower frequency this equivalent current is ~10 times the actual current flowing. At frequencies approaching 50 Mc/s the equivalent current drops to a factor ~0.5 and may be considerably lower for unexamined frequencies above 50 Mc/s.

621.385.13

6295 ANODE LUMINESCENCE IN OXIDE-CATHODE RECEIVING VALVES. H.N.Daglish.

Proc. Instn Elect. Engrs, Paper 3308 E, publ. Sept., 1960 (Vol. 107B, 481-4).

During life test, Post Office underwater-repeater-valves and other receiving-type valves exhibit a blue luminescent pattern on the inner surfaces of the anode. The nature and some of the properties of the luminescent material are examined, and it is concluded that the actual material is barium and/or strontium oxide transferred from the cathode coating during processing.

621.385.2

6296 UNSTABLE ELECTRON FLOW IN A DIODE. R.J.Lomax.

Proc. Instn Elect. Engrs, Monogr. 402 E, publ. Sept., 1960. 3pp. To be republished in Part C.

A perturbation analysis is used to demonstrate the instability of a type of electron flow in a plane diode known as C-overlap flow, which is predicted to be a possible flow in the approximation in which electrons are emitted from the cathode with a uniform velocity.

621.385.2 : 537.533

6297 ANALOG STUDY OF LARGE-SIGNAL HIGH-FREQUENCY DIODES. C.L.Andrews.

J. appl. Phys., Vol. 31, No. 8, 1431-7 (Aug., 1960).

A rolling-ball analogue for the motion of electrons in a high-frequency longitudinal field was developed in which the balls, injected at regular time intervals, plotted photographically a family of graphs of distance against time, indicated the electron bunching, velocity modulation, and density modulation. From these graphs the current densities were found as a function of time for a series of equally spaced positions between cathode and anode, and the anode current induced by the electron stream was computed. Graphs of conductance against transit angle revealed that the conductance was independent of the size of signal for indices of modulation 0.25, 0.50, and 0.75. When the transit angle was 2π the induced anode current was almost pure first harmonic plus d.c. When the transit angle was 3π the first harmonic disappeared.

621.385.3

6298 SMALL-SIGNAL PERFORMANCE AND NOISE PROPERTIES OF MICROWAVE TRIODES. M.T.Vlaardingerbroek.

Philips Res. Rep., Vol. 15, No. 2, 124-222 (April, 1960).

Reports a theoretical and experimental study of the behaviour of a microwave triode at 4 Gc/s. The equivalent circuit of the triode is deduced. The internal feedback is accounted for by a series-resonant circuit in the grid lead. The noise behaviour is described by a noise-current source and a noise-voltage source connected to the input terminals of the equivalent circuit. Those elements of the equivalent circuit which result from the presence of electrons in the active space and the noise sources are calculated on the basis of the single-velocity transit-time theory of Llewellyn and Petersen. Four phenomenological constants are introduced, to account for the effects of the electrons returning in front of the potential minimum and for the multi-velocity effects on the original "Rack" velocity fluctuation and the convection-current fluctuation at the cathode surface. The methods of measurement necessary for the determination of the fourpole coefficients of the triode and its four characteristic noise quantities, giving the magnitudes of the noise sources and their cross-correlation, are described. These methods are complicated because the distance between the measuring devices and the object under study is of the order of several wavelengths. Conclusions reached are: (1) the electronic admittances of the triode can be calculated with reasonable accuracy on the basis of the single-velocity transit-time theory provided that the current density is so high that the distance from cathode to potential minimum is small compared to the cathode-grid distance: (2) the noise properties of the triode are only slightly affected by total-emission noise, transit-time spread and feedback. The contribution of reflection of electrons at the anode surface to the noise properties of a microwave triode is of some importance and can be estimated: (3) the random emission from the cathode is the most important noise source. The four measured noise quantities can be used for calculating the four phenomenological noise quantities introduced. From the values obtained for the latter quantities, the minimum noise figure and the beam-noise parameters S and Π of an electron-beam amplifier equipped with an identical cathode can be calculated. The results are in reasonable agreement with the measured values of S and Π.

621.385.5

6299 A NEW MINIATURE BEAM-DEFLECTION TUBE. M.B.Knight.

R.C.A. Rev., Vol. 21, No. 2, 266-89 (June, 1960).

A new method for beam-deflection control of anode current was developed and is applied to a tube design that uses beam-deflection control in addition to conventional grid control. The new tube, the 7360, is a nine-pin miniature type especially suitable for use in modulators, demodulators, and convertors. It has an "electron gun" that comprises a cathode, a control grid, and a screen grid; a deflection structure that includes two grid-like deflecting electrodes; and two anodes. Beam currents of several milliamperes can be deflected from one plate to the other by means of a potential difference of a few volts between deflecting electrodes.

621.385.5

6300 PEAKED CHARACTERISTIC PENTODES AND THEIR APPLICATIONS. M.S.Aralov.

Radiotekhnika, Vol. 15, No. 6, 51-61 (June, 1960). In Russian.

A single pentode circuit is described in which the anode current rises to a maximum and returns to zero over the negative control-grid excursion. The screen grid is fed via a resistance from a constant positive voltage and the suppressor grid is held at a constant negative voltage. Variation of the space-charge between these two grids influences the anode characteristic obtained. A table gives particulars of 8 pentodes with which circuits can be constructed having control ratios up to $3.2\,V^{-1}$, and characteristics of the following types: sharp peaked, round peaked, steep (either rising or falling), parabolic, sin, $\sin^2$, circular or elliptical arc. Possible applications, including various oscillating devices, frequency multipliers with a high efficiency of harmonic separation pulse phase/width modulation and full-wave detection are discussed in detail. F.Quelon

621.385.6

6301 AN INTERESTING WAVE AMPLIFIER. J.R.Pierce.

I.R.E. Trans Electron Devices, Vol. ED-7, No. 2, 73-4 (April, 1960).

Concerns the theory and structure of an amplifier involving growing waves.

621.385.6 : 533.5

6302 A MINIATURE TITANIUM PUMP. M.Warnecke and P.C.Moutou.

Vide, Vol. 15, 41-51 (Jan.-Feb., 1960). In French.

Describes and gives the operating characteristics of, a miniature pump of absorbing capacity about 10 000 cm^3 mm Hg, with a speed ~2 litres/sec in the range of pressures from 10^{-5} to 10^{-7} mm Hg for a bombarding power of 26 W, designed for evacuating low-power microwave tubes. The use of a small amount of directly heated titanium getter (absorbing capacity ~1400 cm^3 mm Hg) with a miniature Bayard–Alpert type gauge, for the final stages of evacuating such tubes is also briefly discussed. J.Dutton

621.385.63

6303 HIGH AVERAGE POWER DISSIPATION IN HELIX TUBES. A.H.Iverson.

I.R.E. Trans Electron Devices, Vol. ED-7, No. 2, 74-7 (April, 1960).

By precisely shrinking the glass envelope around the helix to a controlled depth, thus providing an exceptionally low thermal impedance to the outside of the envelope, and passing a suitable coolant over the envelope, it has been found that the power dissipation capability of helix circuits can be extended by more than one order of magnitude. A qualitative analysis indicates that the heat transfer characteristics should be as good as the experimental results indicate.

621.385.632

6304 THEORETICAL POWER OUTPUT AND BANDWIDTH OF TRAVELING-WAVE AMPLIFIERS. H.Sobol and J.E.Rowe.

I.R.E. Trans Electron Devices, Vol. ED-7, No. 2, 84-94 (April, 1960).

Expressions are developed to calculate the theoretical power output of travelling-wave amplifiers using any type of r.f. structure. Calculations are made for helix-type tubes and it is shown how to calculate the power output of tubes using more dispersive structures in terms of calculations made for helix tubes. The principal factors accounting for higher power output of dispersive structures are presented and discussed. The gain and bandwidth of forward-wave helix amplifiers are derived from the small-signal theory as functions of frequency and it is shown that the gain in decibels times the

frequency bandwidth is a constant as a function of helix length for high $\gamma_o a'$ and the gain times the bandwidth squared is a constant for low $\gamma_o a'$.

621.385.633

6305 METHODS OF THEORETICAL INVESTIGATION OF "O"-TYPE FOCUSING. J.E.Picquendar and O.Cahen.
Rev. tech. C.F.T.H., No. 32, 7-40 (Feb., 1960). In French.

Approximate methods of calculating perveance and tracing trajectories of parallel and converging electron beams originating from cathodes of planar and spherical surfaces but arbitrary contours, with space-charge-limited emission. The electrostatic field in the absence of space charge is obtained in an electrolytic tank, and the field due to the space charge and its image (in the cathode, but not anode or focusing electrodes) is calculated by Coulomb's law with the aid of highly simplified assumptions about charge distribution. Numerical formulae, graphs and tables to facilitate use of the methods are presented. Calculation of the effects of a magnetic field and of relativistic electron energies is also discussed.
B.Meltzer

621.385.633.1

6306 PARASITIC MODULATION PHENOMENA IN LONG BEAMS OF "O" CARCINOTRON TYPE. D.Reverdin.
Ann. Radioelect., Vol. 15, 147-68 (April, 1960). In French.

Ion plasma oscillations produce spurious amplitude modulation of the beam current and variations in power output. Also, the amplitude modulation produces frequency modulation. Elimination of the phenomena requires vacuum improvement and the use of ion pumping.
A.H.W.Beck

621.385.633.1 : 621.317.34

6307 NOISE MEASUREMENTS ON AN M-TYPE BACKWARD-WAVE AMPLIFIER. J.R.Anderson.
Proc. Inst. Radio Engrs, Vol. 48, No. 5, 946-7 (May, 1960).

Three types of noise measurement are reported on an M-type backward-wave amplifier operating in the range from 785 Mc/s to 900 Mc/s. They are: (1) noise figure; (2) signal-to-noise ratio; and (3) velocity spread. It is concluded that even with an electron gun which produces a well focused laminar beam, the characteristic energy spread of crossed-field tubes is still present, although, perhaps, to a lesser extent than in similar tubes employing less well behaved beams.
H.L.Nattrass

621.385.64

6308 THE ELECTRONIC ADMITTANCE OF A C.W. MAGNETRON OSCILLATOR. C.G.Lehr and A.J.Kalnajs.
J. Electronics and Control, Vol. 8, No. 1, 19-37 (Jan., 1960).

The space-charge cloud of a magnetron can be represented by an "electronic admittance" placed across the terminals of a lumped-constant equivalent of the tube's r.f. circuit. If this electronic admittance can be measured, many otherwise-baffling performance characteristics (such as operation into a frequency-sensitive load) can be explained. A new admittance measurement method which is both rapid and accurate is presented. The method is applied to the Raytheon QK582, an X-band, c.w., 200-W magnetron. The measurements cover a wide range of operation. The results show that the electronic susceptance (the imaginary part of the electronic admittance) is always positive (capacitive). It varies strongly with r.f. voltage, but is (surprisingly) nearly independent of anode current.

621.385.832

6309 TARGETS FOR STORAGE AND CAMERA TUBES. H.R.Day, H.J.Hannam and P.Wargo.
I.R.E. Trans Electronic Devices, Vol. ED-7, No. 2, 78-83 (April, 1960).

Several new information storage targets have been developed for use in storage tubes and camera tubes. One, a double-sided mosaic, is useful primarily in storage tubes. The others, based upon the use of thin self-supported films of magnesium oxide, can be used in many tubes.

621.385.833 : 537.533

6310 NUMERICAL INVESTIGATION OF A RANGE OF UNIPOTENTIAL ELECTRON LENSES. J.Vine.
Brit. J. appl. Phys., Vol. 11, No. 9, 408-11 (Sept., 1960).

An electronic digital computer has been applied to the computation of focal lengths and spherical aberration constants of unipotential lenses, utilizing field data obtained from a resistance network analogue. Results obtained are presented in graphical form and shown to be in good agreement with published experimental results, but not, in the case of spherical aberration constants, with results based on analytical approximation to the axial potential distributions. The sources of error in the computations are discussed, and the accuracy of the results estimated.

621.385.833

6311 CONTRIBUTIONS TO THE KNOWLEDGE OF EXCESS NOISE. H.P.Louis.
I.R.E. Trans Electron Devices, Vol. ED-7, No. 2, 95-9 (April, 1960).

Describes measurements on the noise behaviour of a long, magnetically focused electron beam with a convergent Pierce-type electron gun having a shielded cathode. It is found that the excess noise phenomenon is initiated by a scallop-beam amplification and is essentially dependent on the non-laminarity of electron flow in the beam. The beam reaches a state of high thermal equilibrium which may be caused by strong electron–electron interaction. An estimation shows that this should be theoretically possible.

621.385.833 : 537.533

6312 THREE-DIMENSIONAL SPACE CHARGE FLOW. J.Rosenblatt.
J. appl. Phys., Vol. 31, No. 8, 1371-7 (Aug., 1960).

The general theory of stationary beams of prescribed shape is developed taking into account the electrostatic interaction between the particles. The Hamilton–Jacobi equation, expressed in a particular system of coordinates, allows the determination of the potential distribution inside the beam. Compatibility conditions for the equations are obtained, as well as a general rule for the determination of the feasibility of arbitrarily chosen trajectories. A theoretical expression results for the proportionality coefficient k in Child's law ($J = kV^{3/2}$) which relates current density J with the potential difference V between electrodes. The theory was applied to the particular case of a plane beam with hyperbolic boundaries. The beam was experimentally reproduced, providing values for k in close agreement with the theoretical ones.

621.385.833

6313 STUDY AND DESCRIPTION OF A MACHINE FOR TESTING [ELECTRON] GUNS WITH AUTOMATIC RECORDING OF CURRENT DENSITY. M.Arnaud.
Rev. tech. C.F.T.H., No. 32, 73-82 (Feb., 1960). In French.

Describes an assembly for testing electron guns of various types and sizes. The assembly consists of a pumping system, measuring circuits, a system for analysing the current distribution over the beam cross-section, a focussing system and an arrangement for attaching high-frequency circuits to the gun for measuring tube performance.
R.C.Glass

621.386.7

6314 X-RAY VISUALIZATION AND ANALYSIS USING SPECTRAL INFORMATION. R.S.Mackay.
I.R.E. Trans Med. Electronics, Vol. EM-7, No. 2, 77-9 (April, 1960).

An electronic X-ray system is described which allows more information to be obtained than the usual radiographic methods which lump together the effects of different wavelengths. It gives high contrast images and allows otherwise unnoticeable detail to be detected with a quantitative evaluation of composition. The system has been used to visualize a normal thyroid and analyse it for normal iodine distribution, though a thyroid gland cannot usually be seen at all in a radiograph. An analogy with a new electrocardiographic method is noted.

621.386.8 : 621.389 : 61

6315 ELECTRONIC SWITCHING OF THE EXPOSURE TIMES IN X-RAY APPARATUS. A.Pfahnl.
Z. angew. Phys., Vol. 12, No. 7, 329-34 (July, 1960). In German.

Reviews the advantages and application of electronic control of exposure time of diagnostic X-ray tubes especially for successive exposures each lasting for only a matter of milliseconds. The principal circuits that were evolved to meet this need are described. It is pointed out that some of these circuits have the additional advantage of stabilizing the tube voltage.
T.Mulvey

GAS DISCHARGES
GAS-DISCHARGE TUBES

621.387 : 621.316.5

6316 ON THE EFFECT OF THE GUIDE-BAR FIELD ON THE DEVELOPMENT AND MOVEMENT OF ARC SPOTS. D.Hesse.
Arch. Elektrotech. (Berlin), Vol. 45, No. 3, 188-208 (1960). In German.

Experiments are described in which direct current arcs, carrying currents in the range 100-1400 A, are driven along two parallel bar electrodes by the magnetic field between them. Oscillograph records of impulses from photocells along the arc path enable its velocity to be obtained: the arc voltage and current were simultaneously recorded. Photographs of arcs are also given. The dependence of the spacing and profile of rectangular section electrodes on the arc velocity was studied and three modes were distinguished. For velocities exceeding 50 m/s the arc form is determined by the aerodynamic resistance to motion. For velocities below 25 m/s stability of the anode spot is the predominating influence. Suggestions are made for dimensions of arcing horns on switch gear to enable rapid arc extinction. T.R.Foord

621.387

6317 ON THE ARC MIGRATION IN NARROW INSULATED SLITS AT CURRENTS UP TO 200 kA. E.Kuhnert.
Elektrotech. Z. (E.T.Z.) A, Vol. 81, No. 11, 401-4 (May 23, 1960). In German.

Theoretical considerations on the effects of electric and aerodynamic forces on arc movement are followed by some experimental data on a simplified arrangement with and without pressure relief slots. P.Linton

621.387 : 537.533

6318 HIGH-VOLTAGE ELECTRON EXTRACTION FROM AN ARC-DISCHARGE PLASMA. K.G.Hernqvist.
R.C.A. Rev., Vol. 21, No. 2, 170-83 (June, 1960).

A method of using an arc-discharge plasma as an electron source for producing very high current-density electron-beams in vacuum is described. Electrons are extracted from a magnetically confined mercury-pool arc. A theoretical upper limit for the vapour pressure in the extraction region is derived, and results of tests on an electrode configuration satisfying this pressure requirement are given. For a certain beam voltage, instabilities occur in the extracted current above a value of current density which can be directly related to the 3/2-power law for the electron sheath in the extraction region. Stable beams having current densities of 30 A/cm^2 were obtained for beam voltages of 1 kV.

621.387

6319 BREAKDOWN BETWEEN A CONDUCTOR AND A SPHERE. A.Veverka and V.Kreisinger.
Prace Ustavu pro Elektrotech. CSAV, No. 9, 9-28 (1958). In Czech.

A statistical evaluation of breakdown voltage measurements between a long cylindrical conductor and a sphere was made. The tests were carried out at 50 c/s using a sphere of 150 mm diam. and conductors of 0.5, 1, 1.5, 2, 2.5, 3, 3.5 and 4 mm diam. The shortest distance between the sphere and conductor was varied between 10 and 60 mm in 10 mm steps. The evaluation has shown that the breakdown depended on the conductor position and on conductor diameter. In the case of conductors of diameters smaller than 2.8 mm the discharge originated from corona and the breakdown voltages measured were rather high. In the case of larger conductor diameters the breakdown was caused by an avalanche and the breakdown voltages were comparatively lower. Breakdown voltage calculations are given for conductors having small diameters and calculated results compared with test results. E.Erdélyi

621.387

6320 THE STREAMER-DISCHARGE AND ITS TRANSITION TO A GLOW. W.Hermstein.
Arch. Elektrotech. (Berlin), Vol. 45, No. 3, 209-24 (1960). In German.

Anode corona onset and spark breakdown characteristics for air at atmospheric pressure with a number of sphere-to-plane and concentric spherical electrode configurations are given. Particular attention is paid to the conditions unfavourable for growth of a streamer into a spark but which lead to a glow discharge at the anode and are associated with a considerable increase in breakdown strength. Experiments in which this transition may be controlled are described and a new explanation of this effect is claimed. T.R.Foord

621.387

6321 POWER RELATIONSHIPS AND TEMPERATURE DEPENDENCE IN THE D.-C. CORONA FIELD. J.B.Thomas, T.R.Williams and T.Suzuki.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 1-4 (1960) = Commun. and Electronics, No. 47 (March, 1960).

Current—voltage characteristics are shown for corona in a coaxial cylindrical electrode system. The effect of heating the inner conductor to temperatures between 130 and 1075°F is investigated for positive and negative d.c. and pulse voltages. J.H.Mason

621.387 : 537.52

6322 THE PHENOMENA OF INTERNAL INSTABILITY OF AN ARC WITH A MERCURY CATHODE. I. SPONTANEOUS EXTINCTIONS OF THE ARC. I.G.Kesaev.
Zh. tekh. Fiz., Vol. 29, No. 12, 1462-72 (Dec., 1959). In Russian.

A statistical investigation was made of spontaneous extinctions of an arc in the low-current region. The mean life of the arc, Θ, was taken as the measure of instability. The investigations included the determination of the dependence of Θ on parameters of the external circuit (average current, inductance of the circuit, capacitance across the electrodes), and on internal conditions of the discharge (presence of inert gases and air, and the effect of longitudinal magnetic field on the arc). Z.Krasucki

621.387 : 621.314.65

6323 BEHAVIOUR OF THE ION-SHEATH DURING THE DEIONIZATION PROCESS IN MERCURY-ARC RECTIFIER. F.Nakamura, Y.Ikeda and N.Yamada.
Bull. Fac. Engng Yokohama Nat. Univ., Vol. 9, 93-102 (March, 1960).

An experimental study of the deion process using a tube with intermediate electrodes between anode and cathode. The time variation of the plasma decay was observed. High frequency oscillation (tens of megacycles/sec) phenomena were observed. A.H.W.Beck

621.387 : 537.52

6324 THE ANODE REGION IN A LOW-PRESSURE GAS DISCHARGE. III. THE APPEARANCE OF ADDITIONAL PLASMAS ON THE ANODE (ANODE SPOTS). B.N.Klyarfel'd and N.A.Neretina.
Zh. tekh. Fiz., Vol. 30, No. 2, 186-98 (Feb., 1960). In Russian.

For Pt II, see Abstr. 9037 of 1960. A detailed study was made of anode spots in mercury vapour, inert gases and hydrogen. Inserting a probe into the spot from the direction of the anode facilitated the investigation of the properties of the spot itself. The distribution of spots on the anode in the form of a regular pattern is explained by the interaction of each spot with the surrounding discharge space. Z.Krasucki

621.387.424 : 539.1.07

6325 REDUCTION OF DEAD-TIME IN HALOGEN-QUENCHED GEIGER COUNTERS. B.B.Trott.
J. sci. Instrum., Vol. 37, No. 9, 336-9 (Sept., 1960).

A new type of charge-reduction has been found with a halogen-quenched X-ray Geiger counter. A practical circuit has been developed which reduces the effective dead-time of the counter by a factor of ten. The dead-times were measured by a new method.

ELECTRONIC EQUIPMENT

621.389 : 621.397.62

MEDIUM SCREEN COLOUR (TELEVISION) PROJECTOR. See Abstr. 5863

621.389 : 621.395.2

NEW COMBINATION LUMINOUS CALL AND INTERCOMMUNICATION SYSTEM FOR HOSPITALS. See Abstr. 5742

621.389 : 621-52

SOME APPLICATIONS OF ELECTRONIC EQUIPMENT TO AGRICULTURE. See Abstr. 6515

MEDICAL ELECTRONICS

621.389

6326 PHYSIOLOGICAL EFFECTS OF CONDENSER DISCHARGES WITH APPLICATION TO TISSUE STIMULATION AND VENTRICULAR DEFIBRILLATION. R.S.Mackay and S.E.Leeds. I.R.E. Trans Med. Electronics, Vol. ME-7, No. 2, 104-10 (April, 1960).

The experiments reported first define that property of an electrical discharge upon which the ability to stimulate living tissue depends, in particular the ability to produce a saturation stimulation of the heart. It is then demonstrated that intense capacitor discharges through the chest need not produce any deleterious effects. It is also shown that one can produce defibrillation of the ventricles of a canine heart, through the closed chest, by such a discharge.

621.389 : 621.386.8 : 61

ELECTRONIC SWITCHING OF THE EXPOSURE TIMES IN X-RAY APPARATUS. See Abstr. 6315

621.389 : 681.142 : 621.391

HUMAN MEMORY AS AN INFORMATION STORE. See Abstr. 6328

TELECOMMUNICATION

621.391 : 534.22

6327 THE RANDOMIZATION OF COMBINATIONS OF NOISE SOURCES BY MEANS OF DELAY LINES. D.G.Tucker. Acustica, Vol. 7, No. 6, 399-402 (1957).

A discussion is given of the correlation between the outputs of the two ends of a delay line, or between the corresponding outputs of two different delay lines, when a number of narrow-band noise sources, identical except that their outputs are all uncorrelated, are connected to points uniformly distributed along the delay lines. It is shown that when the total phase-shift in a delay line has a suitable value (e.g. $\pm\pi$ radians if the number of sources is large), the outputs at the two ends are quite uncorrelated, and that if the differences between the total phase-shifts of two delay lines has a suitable value ($\pm\pi$ radians as before, if the number of sources is large, but not the same as before if the number is small), then the outputs of the two lines are uncorrelated. The application of these results to the calculation of the noise factor of acoustic strip arrays is also discussed.

621.391 : 681.142 : 621.389

6328 THE HUMAN MEMORY AS AN INFORMATION STORE. E.Schaefer. Elektron. Rdsch., Vol. 14, No. 3, 79-84 (March, 1960). In German.

A review paper summarizing much of what is known about the human brain from the functional point of view and contrasting its capacity with mechanical devices; a bibliography refers to the original papers. The maximum capacity of the working store in the brain is about 10^{12} bits compared with 10^5 to 10^9 bits for a computor. The storage density ranges from 10^{12} to 10^{29} bits/cm^3 whereas physical devices do not exceed 10^4 bits/cm^3. The error probability ranges from 1 in 10^3 for a neuron to 1 in 10^{12} for the brain compared with 1 in 10^9 to 1 in 10^{15} for various physical devices. The cost ranges from 0.001 to 0.01 DM/bit for tape storage up to 300 to 3000 DM/hr for a calculating machine compared with 1 to 25 DM/hr for a man. The access time per bit of storage can be about 10^{-11} sec. for a physical device and 10^{-10} sec. for the human brain; the brain consumes about 100 W and a transistor machine 10^6 watts. G.A.Montgomerie

621.391

6329 OPTIMUM SYSTEM THEORY USING A GENERAL BAYES CRITERION. V.S.Pugachev. I.R.E. Trans Inform. Theory, Vol. IT-6, No. 1, 4-7 (March, 1960).

An extension of the general method developed by the author (see Abstr. 5136 of 1960) of obtaining an optimum system to include the case of nonlinear dependence of the observed function on signal parameters is given. The method enables optimum systems for the detection and reproduction of signals in the presence of noise using various practically adequate criteria to be determined.

621.391

6330 QUANTIZING FOR MINIMUM DISTORTION. J.Max. I.R.E. Trans Inform. Theory, Vol. IT-6, No. 1, 7-12 (March, 1960).

Discusses the problem of the minimization of the distortion of a signal by a quantizer when the number of output levels of the quantizer is fixed. The distortion is defined as the expected value of some function of the error between the input and the output of the quantizer. Equations are derived for the parameters of a quantizer with minimum distortion. The equations are not soluble without recourse to numerical methods, so an algorithm is developed to simplify their numerical solution. The case of an input signal with normally distributed amplitude and an expected squared-error distortion-measure is explicitly computed and values of the optimum quantizer parameters are tabulated. The optimization of a quantizer subject to the restriction that both input and output levels be equally spaced is also treated, and appropriate pararmeters are tabulated for the same case as above.

621.391

6331 A NOTE ON P-NARY ADJACENT-ERROR-CORRECTING CODES. B.Elspas. I.R.E. Trans Inform. Theory, Vol. IT-6, No. 1, 13-15 (March, 1960).

Binary group codes described by Abramson (see Abstr. 4395 of 1960) permit the correction of all single errors and all double errors in adjacent digits, with the use of significantly fewer check digits than codes capable of correcting all double-bit errors. This note considers the generalization of Abramson's codes to the p-nary case, where a symbol alphabet consisting of the digits 0, 1, ···, $p-1$ is used for transmission, p being a prime number. Examples of such p-nary codes are given, as well as necessary conditions for their existence. These codes bear the same relation to the p-nary Golay codes as Abramson's codes do to the familiar Hamming codes. Some as yet unanswered questions are raised, and suggestions for further possible generalizations are given.

621.391

6332 CODES FOR THE CORRECTION OF "CLUSTERED" ERRORS. S.H.Reiger. I.R.E. Trans Inform. Theory, Vol. IT-6, No. 1, 16-21 (March, 1960).

A method is described which permits the systematic construction of codes capable of error-free transmission, provided errors occur in "clusters" of limited duration. The method is valid for error clusters of any prescribed duration. The codes are relatively easy to implement and decoding operations are straight forward. Specific examples are given and applications to teletype transmission are discussed.

621.391

6333 A CLASS OF CODES FOR SIGNALING ON A NOISY CONTINUOUS CHANNEL. J.L.Kelly, Jr. I.R.E. Trans Inform. Theory, Vol. IT-6, No. 1, 22-4 (March, 1960).

A class of codes for continuous channels is described. These are block codes in which the code words can be computed from a much smaller set of generators. It is shown that codes of this type exist which will yield arbitrarily small error rates at any signalling rate below channel capacity. In fact, if the generators are chosen at random, it is shown that the expected error rate obeys a bound established by Shannon for general random codes.

621.391

6334 A BIBLIOGRAPHY OF INFORMATION THEORY (COMMUNICATION THEORY–CYBERNETICS). THIRD SUPPLEMENT. F.L.H.M.Stumpers. I.R.E. Trans Inform. Theory, Vol. IT-6, No. 1, 25-51 (March, 1960).

For previous supplements see Abstr. 1530 of 1956 and 1553 of 1958.

621.391

6335 A NOTE ON THE STRONG CONVERSE OF THE CODING THEOREM FOR THE GENERAL DISCRETE FINITE-MEMORY CHANNEL. J.Wolfowitz.
Information and Control, Vol. 3, No. 1, 89-93 (March, 1960). (Illinois. J. Math., 2, 454-8 1958).

By a modification of a method previously used by Wolfowitz (1958) the strong converse for the general discrete finite memory channel is proved. The results of previous investigations [Abstr. 6542 A of 1959; Information and Control, Vol. 2, No. 1, 25-44 (April, 1959)], e.g. for memoryless channels are included as special cases of the result obtained. G.D.Sims

621.391

6336 ON A CLASS OF SEMI-SEPARABLE PROCESSES. J.K.Lubbock.
J.Electronics and Control, Vol. 8, No. 1, 67-79 (Jan., 1960).

A class of semi-separable processes can be defined for which the g function separates over the range $t_1 \geq t_2$ thus

$$g(x_1;\ t_1,\ t_2) = \int [x_3 - \langle x_3(t_1)\rangle]\, p_3(x_1, x_3;\ t_1, t_3)\, dx_3 = g_1(x_1, t_1) g_2(t_1,\ t_2)$$

for $t_1 \geq t_2$ only. This class of processes possesses all the properties of Nuttall's separable class, including the invariance property, for $t_1 \geq t_2$ only. It is shown that semi-separability and separability are preserved under linear transformation of x_3. An example of this class of processes is given and its importance in nonlinear filtering and prediction is mentioned.

621.391

6337 ASYNCHRONOUS MULTIPLEXING. J.E.E.Taylor.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 1054-62 (1960) = Commun. and Electronics, No. 46 (Jan., 1960).

The theoretical limitations and capabilities are considered of general types of asynchronous multiplexing systems in which all stations belonging to one channel are in communication with each other. The purpose of the multiplexing system is to provide this communication when stations of all channels use a common transmission medium in which signals and noise mix additively. Such a system is for example encountered in mobile communications where the individual communication paths vary widely in direction and length. Frequency-division multiplex is a well known asynchronous system and is considered here only as a comparison standard. The exclusion of frequency division coupled with requirements of no synchronization and finite time-duration waveforms implies that channels will transmit non-orthogonal signals. A pair of non-orthogonal signals are such that the energy contained in one is not completely separable from that contained in the other. The types of system considered are those in which the modulation signal-to-noise ratio may be assumed to be sufficiently high at the output of the multiplex decoder for recovery of the messages even though the signal-to-noise ratio in the transmitted time–frequency region is low. Many communication networks of this type are such that very few of the stations in the network transmit during any given interval of time. Thus it is possible to design systems which will provide random access to the communication medium for any assigned station at any time and maintain efficient communication with tolerable interference. There is a critical number of stations which may be in use at any one instant: the interference becomes intolerable when the number of stations in use exceeds this critical number. There are two general methods of applying information theory to the study of asynchronous multiplexing systems: the first of these concerns the synthesis of the best system, while the second deals with the use of information theory in the analysis of specific systems. The various contributions made to the subject in these fields are critically reviewed. S.C.Dunn

TELEGRAPH AND TELEPHONE SYSTEMS

621.394.5

6338 SELECTIVE CALLING FOR DATA LINK SYSTEMS. [SELCAL]. A.I.Perlin.
Electronics, Vol. 33, No. 18, 108-10 (April 29, 1960).

A remote control equipment is described responsive to a code of five binary-coded decimal "words" consisting of a "1" followed by 4 bits (1 or 0), frequency-coded. The equipment is based on the use of multi-purpose standardized modules using primarily transistors, and strappable at external terminals for the various circuit configurations required. The transmitting station is a long serial shift register with switch or dial selection of a five-digit call, followed by actuation by a push-button. The receiver is set to select the relative five-digit address by means of five 10-position switches. The system basically serves only to call a station, or to alert an operator, but may be used to initiate a reply. It is asserted that the system will correctly identify 100% of messages sent over a link having a noise-to-signal ratio of 6 dB, 90% at 8 dB, and that no false alarms are present below 10 dB. W.J.Mitchell

621.395.31

6339 A NEW METHOD FOR THE DETERMINATION OF OVERLOADED TELEPHONE CONNECTIONS. A.Rose.
Nachrichtentech. Z. (N.T.Z.), Vol. 13, No. 4, 169-70 (April, 1960). In German.

Determination of overloading as a "condition" is more difficult in the case of subscribers' lines than in the case of toll lines or selector stages, and it is asserted that the conventional methods of examining customer's complaints, evidence of busy condition found by toll exchanges, number of local fee units registered and final selector observation by maintenance staff are all inconclusive for one reason or another. A new method is described which involves a routine metering technique at the final selector. A relay coupler is plugged into the test jack of each final selector to be observed, and causes a printed record to be made on a tape of each line circuit of the selector under test in response to the tens and units digit of the line when dialled, and the occurrence of busy back tone on the line. The record is in the form of a rectangular waveform indicating free and occupied condition, with spikes for each "busy" condition encountered. Time indications at 5 minute intervals are also shown. 10 References. W.J.Mitchell

621.395.341.8 : 681.142

6340 A TELEPHONE TRAFFIC DISTRIBUTION RECORDING PROJECT. E.G.Wormald.
Instn Engrs, Austral., elect. mech. Engng Trans, Vol. EM I, No. 1, 24-43 (May, 1959).

Planning for Sydney and Melbourne metropolitan telephone networks has been hampered by an inability to determine the amount of traffic flowing from one exchange to another, except in certain special cases. Impending changes in network configuration and the probable introduction of new types of switching equipment make a detailed knowledge of the originating traffic distribution essential. Semi-portable equipment has been developed to automatically record dialling and holding time information about samples of the traffic originating in an exchange. The record is in the form of specially coded perforated paper (telegraph) tape which is subsequently processed by the digital computer "Silliac" in the Adolph Basser Computing Laboratory at Sydney University. Results are in the form of tables for each exchange showing the proportion of sampled originating traffic directed to each destination in the network. The reasons for the project, are outlined and the way in which the data are recorded and processed is described.

621.395.44

6341 A TELEPHONE CARRIER SYSTEM FOR FAR WESTERN N.S.W. F.Hailstone.
J. Instn Engrs Australia, Vol. 31, No. 1-2. 35-9 (Jan.-Feb., 1959).

A short survey is given of the particular problems encountered in this region. The economics of choosing between h.f. radio, v.h.f. radio and v.f. carrier are important because of the problems met due to the difficult country. There are also a number of single-leg trunk circuits using 400 lb and 500 lb galvanized iron wire. The 1 kc/s equivalent of such a trunk 120 miles long is 20 dB and when a subcriber 50 miles away from the exchange is connected, conversation is often impossible. There circuits suffer badly also from noise due to atmospheric storms, dust and high winds and unwanted noise levels of 1 mW have been measured. Introduction of receiver gain makes matters worse and the only solution is improved signal-to-noise ratio. The equipment is entirely transistorized which results in a power consumption of only 10 w from a 32-V d.c. source. An improvement in signal to noise of 20 dB was achieved. General circuit considerations are discussed and a description of the circuits of the carrier and ringer oscillators, amplifiers, modulators and demodulators etc. is given. B.B.Austin

621.395.44

6342 MEASURING AND ADJUSTMENT METHODS FOR EQUALIZATION AND SUPERVISION OF CARRIER SYSTEMS ON SYMMETRICAL CABLE CIRCUITS.
M.Bidlingmaier, W.Ebenau and F.Feil.
Nachrichtentech. Z. (N.T.Z.), Vol. 13, No. 1, 34-41 (Jan., 1960). In German.

Frequency-dependent attenuation and the temperature changes of cable circuits used in Germany for the V60 and V120 carrier systems, and the international limits for attenuation variations, are analysed. Methods of equalization are described. Commissioning of a new carrier circuit begins with measurement of the frequency response of the sectors and of the entire circuit, either point-by-point with a level meter, or by using a wobbulator and a visual display. Supervision and additional equalization of carrier systems in operation by means of pilot frequencies is described. Routine measurements are listed and briefly explained with particular emphasis on the use of gap frequencies. Some photographs of instruments are produced. J.M.Silberstein

621.395.44 : 621.315.687.1 : 621.395.741

EFFECTIVE SPLICING METHODS IN CARRIER CABLES.
See Abstr. 5754

621.395.6

6343 BANDWIDTH COMPRESSION BY MEANS OF VOCODERS. F.H.Slaymaker.
I.R.E. Trans Audio, Vol. AU-8, No. 1, 20-6 (Jan.-Feb., 1960).

Speech information may be transmitted over a bandwidth one tenth of that required for the original speech if attention is directed toward reproducing the envelope of the power density spectrum rather than the waveform itself. Pitch information can be transmitted independently of the spectrum information and the two sets of signals combined at the receiving end to resynthesize the original speech sounds. In the vocoder the power spectrum is analysed and synthesized by means of band-pass filters. The energy for the voiced sounds is obtained from an oscillator called a buzz source, and for the fricative consonants the energy is obtained from a white noise source.

TELEPHONE EQUIPMENT
COMMUNICATION NETWORKS AND CABLES

621.395.636.1

6344 HUMAN FACTORS ENGINEERING STUDIES OF THE DESIGN AND USE OF PUSHBUTTON TELEPHONE SETS.
R.L.Deininger.
Bell. Syst. tech. J., Vol. 39, No. 4, 995-1012 (July, 1960).

The studies reported consider the desirable characteristics of pushbuttons for use in 500-type telephone sets and also questions of how people process information when keying telephone numbers. Four categories of design features were studied: key arrangement, force–displacement characteristics, button-top design and central office factors. The results indicate that considerable latitude exists for key set design in terms of user performance; however, the preference judgments are more selective. The studies also showed that the manner in which the person acquired and keyed the telephone number influenced performance appreciably.

621.395.74 : 621.391.823

6345 INTERFERENCE IN RAILWAY LINE-SIDE TELEPHONE CABLE CIRCUITS FROM 25 kV 50 c/s TRACTION SYSTEMS. A.Rosen.
A.T.E. J., Vol. 15, No. 4, 279-99 (Oct., 1959).

Experience already gained, particularly in Europe, in the solution of this interference problem is briefly reviewed. Relevant C.C.I.F. recommendations are then stated. A calculation is made of the induced e.m.f. due to magnetic induction and analyses are given of the effectiveness of electromagnetic screening by cable sheath and by an external conductor. The effect of variations in resistance to earth on screening factor is examined. The current in the rails and in the traction system and certain sheath current effects are discussed and the effect of induced voltage on screening factor and the problems of noise and corrosion are examined. A description is given of recent work on a pilot electrification scheme to illustrate the principles discussed. Brief notes are given on the use of booster transformers to reduce interference and on the special problems of interference in railway signalling cables.

621.395.74 : 621.391.823

6346 PROTECTION OF TELECOMMUNICATION INSTALLATIONS WHEN MEETING OTHER INSTALLATIONS. H.Graf.
Nachrichtentechnik, Vol. 9, No. 11, 481-5 (Nov., 1959). In German.

Deals mainly with the legal aspects of the problem as seen in Eastern Germany. Rules for the protection of telecommunication installations against electrical interference and mechanical damage are surveyed and possible remedies are listed. Defrayment of costs is determined, generally, by priority; but protective measures might be applied to an existing installation, if this is more economical. H.R.J.Klewe

ELECTROACOUSTIC APPARATUS

621.395.61

6347 CALIBRATION AND RATING OF MICROPHONES. W.B.Snow.
I.R.E. Trans Audio, Vol. AU-8, No. 1, 5-13 (Jan.-Feb., 1960).

Calibrations can be made with pure tones or with wide-band signals such as noise or warbled tones. Complete calibration includes measurements of directivity and impedance as well as linearity of response. From the calibrations it is possible to calculate ratings which give quick and relatively fair comparisons between microphones. The R.E.T.M.A. rating is particularly effective for the commercial types with impedance <0.2 MΩ. For small crystal and capacitor microphones a statement of the noise threshold is more indicative of true performance capability. Although complete specification of microphone performance requires considerable information, the ratings dispel the main ambiguities in response figures arising from differences in impedance, circuits and test sound pressures.

621.395.61 : 621.396.97 : 534.84

6348 DIFFUSION OF SOUND IN SMALL ROOMS. K.E.Randall and F.L.Ward.
Proc. Instn Elect. Engrs, Paper 3272E, publ. Sept., 1960 (Vol. 107B, 439-50).

Describes an investigation of some problems of sound diffusion in rooms, with particular reference to small sound and television studios. The experimental work shows that it is possible to measure the degree of diffusion in a room by fairly simple practical techniques. Quantities based on the frequency variation of reverberation time and double reverberation decay constants are the most promising for use in small broadcasting studios. It is also shown that uniform distribution of absorption can be as effective as other means of attaining conditions of good diffusion. Rectangular diffusers are particularly effective in improving conditions where the distribution of absorption is poor.

621.395.623.7

6349 THE INFLUENCE OF AIR-GAP DIMENSIONS OF A CONCENTRIC GAP MAGNET SYSTEM ON THE ELECTROACOUSTIC EFFICIENCY OF LOUDSPEAKERS. F.Unger.
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 4, 125-7 (Nov., 1959). In German.

The efficiency of the loudspeaker is derived from considerations involving the gap proportions, an ideal leakage-free magnet working at its optimum point being assumed. The mass of the diaphragm, coil and air load are also involved. Curves are plotted relating efficiency to the parameters and a practical example is taken. M.L.Gayford

621.395.623.7

6350 STEREOPHONIC PROJECTION CONSOLE. B.B.Bauer and G.W.Sioles.
I.R.E. Trans Audio, Vol. Au-8, No. 1, 13-16 (Jan.-Feb., 1960).

A system is described for home stereophonic reproduction from a single cabinet by reflection of sound from the room boundaries. The effect is emphasized by using loudspeakers which maintain a uniform cardioid directional pattern over the useful frequency range. The directional properties are obtained with acoustic phase-shift networks.

621.395.625.3

6351 THE REGISTRATION ACCURACY OF MAGNETIC-TAPE RECORDING. H.Völz.
Elektron. Rdsch., Vol. 14, No. 1, 23-5 (Jan., 1960). In German.

Registration accuracy becomes significant when magnetic tape

is used as a store for quantitative information. By means of the information theory the channel capacity of the tape is first derived, taking account of the basic noise level and of the amplitude-and frequency-modulation arising from tape and drive imperfections. As a result, the number of distinguishable amplitude stages between noise and saturation level is shown to be about 48, giving a corresponding figure for the measurement error of about 2%.

H.G.M.Spratt

621.395.625.3

6352 HOW ENVIRONMENT AFFECTS MAGNETIC RECORDING TAPE. C.B.Stanley.

I.R.E. Trans Space Electronics and Telemetry, Vol. SET-6, No. 1, 19-24 (March, 1960).

Among the criteria examined are the dimensional stability, strength and toughness of the substrate, and the chemical stability of the binder and the magnetic material. Unexpected physical effects can be experienced within the generally accepted "safe" environmental limits. Critical temperatures and observed effects are described.

621.395.625.3

6353 ON CERTAIN BASIC CONCEPTS AND TERMS IN THE THEORY OF MAGNETIC RECORDING. V.A.Geranin.

Radiotekhnika, Vol. 15, No. 6, 74-6 (June, 1960). In Russian.

A discussion of ambiguities in certain aspects of the international terminology. In order to reduce confusion, three new terms (concepts) are suggested: (1) "magnetic signalogram"—for any magnetic medium on which a signal has been recorded, irrespective of the nature of the signal or type of modulation: (2) "output effect"—for that part of the flux from a magnetic signalogram which enters the working surface of the reproducing element: (3) a quantity to represent the "loss resulting from the self-demagnetization in a signalogram", to be defined by the ratio of the amplitude of the internal magnetic induction (averaged through the thickness of the medium) of the medium to the amplitude of its remanent magnetization.

F.Quelon

621.395.625.3 : 681.142

HIGH DENSITY DIGITAL MAGNETIC RECORDING TECHNIQUES. See Abstr. 6535

621.395.625.6

6354 "T.P.R." RECORDING.

Electronic Industr., Vol. 19, No. 2, 76-9 (Feb., 1960).

This new electron–optical technique operates by producing ripples on transparent film. The film base is coated with a conducting film and again, on top of it, with a thermoplastic film. The input signal is similar to that required for magnetic recording and is applied to an electron beam which scans the moving film transversely so as to produce electrostatic charges corresponding to the instantaneous beam current. After passing the beam the thermoplastic film is momentarily softened by heat with the result that the charges are attracted to the conducting film below and the surface of the thermoplastic film is depressed. For the reproduction of black and white pictures a modification of the Schlieren optical system is employed. For colour recording additional control signals have to be recorded and a diffraction technique is applied for reproduction. The record can be erased as desired and the film re-used. The data storage capacity of the system is 40×10^6 bits/in^2. The technique has applications in radar, sonar and infrared display storage, missile guidance and the like.

H.G.M.Spratt

RADIOCOMMUNICATION

621.396.2 : 621.396.65

6355 THE TJ RADIO RELAY SYSTEM. J.Gammie and S.D.Hathaway.

Bell Syst. tech. J., Vol. 39, No. 4, 821-77 (July, 1960).

This system is a broadband microwave facility that operates in the 10.7 to 11.7 Gc/s common carrier frequency band. It was specifically designed for short-haul transmission of either multichannel telephone or television circuits. Transmission performance and the over-all system description are presented, as well as some early field applications.

621.396.2 : 621.396.65

6356 THE EXPERIMENTAL 3 cm RADIO RELAY TELEPHONE LINK BETWEEN GOES AND ROOSENDAAL (HOLLAND). L.Krul and J.W.A. v.d. Scheer.

Ingenieur, Vol. 72, No. 28, E. 53 - E. 64 (July 8, 1960). In Dutch.

A 240-channel wide-band (60-1052 kc/s) microwave radiotelephone link equipment was designed for this 40 km link. Thermal noise, intermodulation noise, distribution of noise and the effect of pre-emphasis are discussed. The transmitter uses a reflex klystron with high frequency stability and the thermostat equipment for temperature control to maintain frequency and linearity is is described in some detail. The i.f. amplifier, limiter, demodulator, band-amplifiers and equalization network of the receiver circuit are considered with the aid of block diagrams. The aerials are 3 m dia. parabolic reflectors.

G.N.J.Beck

621.396.2 : 621.396.65

6357 PERFORMANCE OF A 640-MILE, 24-CHANNEL U.H.F.–S.S.B. EXPERIMENTAL COMMUNICATION SYSTEM. B.E.Nichols.

I.R.E. Trans Commun. Syst., Vol. CS-8, No. 1, 26-33 (March, 1960).

A mock-up communication system was installed between Westford, Mass., and Winston-Salem, N.C., providing a 640-mile path as a test circuit to measure performance of a 24-channel u.h.f.–s.s.b. system. The equipment is described, the theoretical performance of the system as to voice quality and signal-to-noise ratio in a telephone channel and simulated teletype error count is shown.

621.396.2 : 621.396.65

6358 ANALYSIS OF THE PERFORMANCE OF THE EDMONTON–YELLOWKNIFE JANET CIRCUIT. J.H.Crysdale.

I.R.E. Trans Commun. Syst., Vol. CS-8, No. 1, 33-40 (March, 1960).

Trials of the Canadian Janet B system were carried out on an auroral zone circuit during July 1958, and from early in December 1958, until the middle of April 1959. The July 1958 trials, which were performed at frequencies in the vicinity of 40 Mc/s, revealed the vulnerability of the system to polar blackout at these frequencies and to excessive error rates with rapidly fluctuating auroral signals. The objective of the trials carried out between December 1958, and April 1959, was the accumulation of long-term statistical data. The test message and operational procedures were designed to permit detailed analysis with an I.B.M. 650 computer. Some preliminary results are included. Because of the basic importance of the polar blackout problem, pertinent experimental data concerning the major blackout of July 1959, are presented and discussed.

621.396.3

6359 A NEW TYPE ELECTRONIC A.F.C. SYSTEM FOR THE RADIO-FREQUENCY F.S. TELEGRAPH CIRCUIT. H.Michishita, K.Kawai, K.Matsuda, T.Tada and M.Otsuka.

J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 4, 545-54 (April, 1960). In Japanese.

Describes the principles, response characteristics and experimental results of an a.f.c. system in which the mark and space frequencies of the f.s. telegraph signal are balanced symmetrically about the centre frequency of the discriminator. A block diagram shows the arrangement of the error-detecting device, in which the mark and space voltages are transformed to pulse waveforms and compared in an integrator consisting of a neon tube, a resistor and a capacitor, the neon tube serving to prevent discharge of the integrated voltage. A detailed circuit diagram is given of the experimental equipment used in tests between Osaka and Hamburg. The good performance of the system is maintained even with very small frequency shifts, and fluctuations of the centre frequency as well as of the amount of frequency shift are dealt with.

A.Wilkinson

TRANSMITTERS . RECEIVERS

621.396.61

6360 PATH-LOSS MEASURING TECHNIQUES AND EQUIPMENT. J.Polyzou and M.Sassler.

I.R.E. Trans Commun. Syst., Vol. CS-8, No. 1, 9-13 (March, 1960).

Describes the techniques and equipment used to evaluate proposed tropospheric-scatter communication installations. The equipment operates in the frequency range of 875 to 940 or 1650 to

1950 Mc/s with output powers of 10 or 100 W. A logarithmic recording system is used which makes possible a dynamic signal recording range of 50 to 100 dB. Automatic frequency control is employed to achieve a 300 c/s 3 dB bandwidth with moderate oscillator stabilities.

621.396.61

6361 TRANSMITTER POWER CONTROL IN TWO-WAY COMMUNICATIONS SYSTEM.

G.S.Axelby and E.F.Osborne.
I.R.E. Trans Commun. Syst., Vol. CS-8, No. 1, 48-56 (March, 1960).

To achieve high system reliability, the current practice is to continuously transmit high power, adequate to maintain r.f. reception during the presence of severe fading. This wastes power and creates serious radio interference during favourable propagation periods. Feedback control is applied to high reliability systems to vary the transmitted power as a function of the fading and consequently (1) to reduce operating cost by conserving transmitted power; and (2) to reduce interference to other radio networks in the area. Other secondary advantages, including reduction of the dynamic range of received signal strength (which will ease receiver a.g.c. and r.f. amplifier design), will be apparent. In order to maintain high system reliability, the automatic control at each site is simultaneous, continuous, and effective for nonreciprocal as well as for reciprocal fading. The system has been referred to as controlled carrier communications.

621.396.61

6362 ENDORADIOSONDES: FURTHER NOTES. R.S.Mackay.

I.R.E. Trans Med. Electronics, Vol. ME-7, No. 2, 67-73 (April, 1960).

A supplement to a previous paper (see Abstr. 1936 of 1960). General comments on procedure as well as specific items such as temperature sensitivity, use of tunnel diodes in pH measurement, use of multiple transmitters, and design of a nondirectional receiving aerial system are included. The latter not only simplifies unattended recording in some cases but also helps in relaying the signal from a small booster transmitter carried by the subject. The frequency-shift needed in relaying action is obtained by frequency-doubling provided by suitable nonlinear receiver circuits.

621.396.611

6363 THE AIR-HEATING, VENTILATION AND CLIMATIZING EQUIPMENT OF THE BISAMBERG HIGH-POWER TRANSMITTER. E.Heyna.

Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 9-10, 245-8 (May 1, 1960). In German.

Describes the arrangements for heating or cooling the various rooms in the station buildings, automatic adjustment of room temperatures and moisture content of the air to specified values for summer and winter, and efficient utilization of waste heat from the transmitter equipment. A.Wilkinson

621.396.62

6364 THE EFFECTIVENESS OF METHODS OF INCREASING THE DYNAMIC RANGE OF PANORAMIC RECEIVERS.

N.I.Svetlov.
Radiotekhnika, Vol. 15, No. 5, 29-32 (May, 1960). In Russian.

Compares theoretically the familiar methods: (1) of applying negative feed-back in the wide-band channel; and (2) of using automatically tuned filters in the same stages, with and without feedback as in (1). Experimental data are quoted to support the results. Method (1) is best with small coverage (20-50 kc/s) and (2) with wide coverage (>100 kc/s). D.E.Brown

621.396.621 : 621.398

6365 CAMERA CONTROL SYSTEM FOR ROCKET SLED TESTS. F.M.Gardner and L.R.Hawn.

Electronics, Vol. 33, No. 14, 63-5 (April 1, 1960).

Described a transistorized receiver for frequency-modulated control signals to start a vehicle-borne camera and to operate timing devices. A strip transmission line input band-pass filter rejects the image frequency and passes the 460 Mc/s carrier. The receiver is a double-conversion superheterodyne. The pulse decoding and relay control circuits are also described.

W.G.Stripp

RADIOFREQUENCY EQUIPMENT

621.396.664

6366 THE TRANSMITTER MEASUREMENT AND SUPERVISION EQUIPMENT OF THE BISAMBERG HIGH-POWER TRANSMITTING STATION. L.Jelinek.

Elektrotech. u. Maschinenbau (E.u.M.), Vol. 77, No. 9-10, 225-30 (May 1, 1960). In German.

A general description of the equipment. Details of the ranges of the various instruments are tabulated. A.Wilkinson

AERIALS

621.396.67

6367 RADIATION PATTERN SYNTHESIS WITH SOURCES LOCATED ON A CONICAL SURFACE.

A.Ishimaru and G.Held.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 91-6 (Jan., 1960).

Presents various methods of synthesizing sources placed on a conical surface to produce a prescribed radiation pattern. The sources considered are a series of electric dipoles placed in free space on the surface of the cone around a set of circumferences. These circumferences are equidistant from each other, and the dipoles are oriented in the circumferential direction with no circumferential variation in intensity and phase. A successive approximation method is employed to obtain the source function for those sources which are placed in a region where the circumferences measure approximately less than two wavelengths. For sources placed in the region where the circumference is less than approximately $(4/3)\pi$ wavelengths, an expansion formula of the product of the Bessel and exponential functions is employed. When the sources are located far from the cone tip, a method utilizing the maximum points of the Bessel function is used to compute the source function. In considering the beamwidth and the sidelobe level, the Chebyshev pattern with the tapering effect is employed. Numerical examples are given to illustrate the effectiveness of the methods.

621.396.67

6368 A THEOREM REGARDING THE COMMUTATION OF ANTENNA ROTATIONS. L.P.Bolgiano, Jr.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 104-5 (Jan., 1960).

Ordinarily, when an aerial is rotated successively about mutually perpendicular earth-fixed axes such as axes pointing up, north, and west, the order in which the successive rotations are made cannot be reversed without obtaining a very different final aerial orientation. An analytic proof that the same final aerial orientation can always be obtained with the rotation order reversed as with the rotations performed in correct order is given. To accomplish this it is necessary when reversing the order of rotation only to also re-identify the axes of rotation. The required reidentification is obtained by considering the axes as detached from the earth and permitted to turn with the aerial as would lines painted on the aerial before the rotations are begun.

621.396.677

6369 ANTENNA IMAGE QUALITY EVALUATION. I. BY AN OPTICAL SIMULATION METHOD. J.J.Myers.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 78-82 (Jan., 1960).

An optical simulation method was used to study the effect of aperture illumination on image quality for a high resolution aerial. It was determined that an illumination close to uniform yields the best image, as measured by the similarity of the image to the object when similarity was judged by a group of human observers. The techniques used are described, and the results of the evaluation of a typical class of illuminations are given. See also following abstract.

621.396.677

6370 ANTENNA IMAGE QUALITY EVALUATION. II. BY A MECHANICAL OBSERVER. J.J.Myers.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 83-90 (Jan., 1960).

A digital computer was used as a mechanical observer to

evaluate aerial image quality as a function of the aperture illumination for a high resolution aerial. An illumination close to uniform was found to yield an image that was best as measured by the ease with which the mechanical observer was able to analyse the images. A description of the logical design of the observer and the results of applying it to the analysis of a typical class of illuminations are given.

621.396.677

6371 THE INPUT IMPEDANCE OF V-ANTENNA. N.Nasu and Y.Mushiake.

J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 3, 310-16 (March, 1960). In Japanese.

The impedance is calculated, by the e.m.f. method, as the mutual impedance between two identical parallel V-aerials of negligible thickness, the distance between the aerials being equal to the radius of the aerial wires. A lengthy expression for the input impedance is derived in terms of the physical dimensions of the aerial and the wave-length used. The results of numerical computations for various leg-lengths and angles are shown graphically for the cases in which the wire radius is (a) $\lambda/200$, (b) $\lambda/500$. Another diagram shows the effect of change of wire radius, in the range $\lambda/1000$ to $\lambda/50$, for V-aerials of 90° angle and various leg-lengths. The theoretical values of the input impedance are in good agreement with experimental measurements at 200 Mc/s. A.Wilkinson

621.396.677

6372 DETERMINING THE OPERATIONAL PATTERNS OF DIRECTIONAL TV ANTENNAS.

F.G.Kear and S.W.Kershner.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1088-97 (June, 1960).

Tests were carried out in Boston, Massachusetts, and in Oklahoma City, Oklahoma, with special directional aerial systems possessing various degrees of directivity. Measurements were made at distances varying from a few miles to well over 100 miles from the transmitter. Within the limits imposed upon the tests by the choice of sites, nature of the terrain, and a limited period of observation, it was found that propagation conditions did not materially affect the directivity of the array, even at distances where the scatter fields were of appreciable magnitude. In the course of these measurements and tests, a procedure was developed whereby the operational aerial pattern could not only be determined, but also rechecked at suitable intervals thereafter.

621.396.677

6373 TRANSIENT BEHAVIOR OF APERTURE ANTENNAS. C.Polk.

Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1281-8 (July, 1960).

The transient behaviour of aperture aerials is analyzed. For an aerial which is illuminated by a field of uniform phase and either uniform or cosine-tapered amplitude, it is shown that the steady-state main lobe is established within $(\tau/2 + R/c)$ sec after the aperture is energized: τ is the period of the carrier frequency, R is the distance from the centre of the aperture to the point where the field is evaluated, and c is the velocity of light. The time required for the establishment of the steady-state pattern at all angles between 0° and 90° is $(\tau/2\theta_0 + R/c)$ where $2\theta_0$ radians is the beamwidth between first nulls of the steady-state pattern ($\theta_0 \ll 1$). An aerial may be useful, however, before $(\tau/2\theta_0 + R/c)$ sec, because the maxima of the transient sidelobes are not higher than the maxima of the steady-state sidelobes. The requirement that the steady-state pattern be established at all angles between 0° and 90° leads to a limitation on range discrimination ΔR and angular discrimination $\Delta\theta$ for a pulse radar $\Delta R \Delta\theta = \lambda$, where λ is the wavelength of the carrier frequency. For a scanning aerial employing linear phase variation over the aperture, it is shown that the main lobe, located at an angle θ_{max}, is established within a time $(\tau/2 + R/c + a \sin \theta_{max}/2c)$ measured from the instant at which one edge of the aperture is first energized. The quantity a is the dimension of the aperture in the plane in which the field is evaluated.

621.396.677 : 621.396.933.2

6374 THE DESIGN OF CYLINDRICAL METAL-PLATE MICROWAVE LENSES FED BY NON-RESONANT SLOTTED WAVEGUIDE ARRAYS. J.W.Crompton.

Proc. Instn Elect. Engrs Monogr. 382E, publ. May, 1960. (Vol. 107C, 330-3, Sept., 1960).

Republication of the Monograph already abstracted as Abstr. 3755 of 1960.

621.396.677.3

6375 ON UNIFORM AND LINEARLY TAPERED LONG YAGI ANTENNAS. D.L.Sengupta.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 11-17 (Jan., 1960).

Travelling-wave analysis of long Yagi aerials is reviewed briefly. The method of designing a Yagi aerial from this viewpoint is discussed and some experimental results are given in order to verify the analysis. A long Yagi aerial, when designed according to the Hansen and Woodyard condition, has a sidelobe ratio of 9.32 dB in its radiation pattern, irrespective of length. It is shown that by varying the propagation constant linearly along the length of the aerial, the sidelobe ratio can be improved considerably without sacrificing much of the gain. This linear variation of the propagation constant may be obtained by slowly tapering the element lengths and/or element spacings along the length of the aerial. An approximate theory is developed for the linearly tapered Yagi aerial and it is verified by actual measurements. A comparison between radiation patterns of uniform and tapered long Yagi aerials clearly shows the advantage of tapering.

621.396.677.5

6376 RADIATION FIELDS OF CIRCULAR LOOP ANTENNAS BY A DIRECT INTEGRATION PROCESS. E.J.Martin, Jr.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 105-7 (Jan., 1960).

Starting from the radiation characteristics of a differential current element, the vector potential produced by a single-turn circular loop is formulated in terms of a general loop current by a direct integration process. Evaluation of the resulting integrals for a limited number of specific loop current distributions leads to generalized expressions for both the standing-wave and travelling-wave cases. Radiation fields can be found from the integrated vector potential expressions. This technique represents only a slight modification of the one used by Sherman (see Abstr. 538 of 1945), but it extends his work in such a way that the results are equivalent to those obtained by Knudsen (see Abstr. 3824 of 1953) in a somewhat different manner.

621.396.677.7

6377 DESIGN OF CIRCULAR APERTURES FOR NARROW BEAMWIDTH AND LOW SIDELOBES. T.T.Taylor.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 17-22 (Jan., 1960).

Extends a method of design described earlier (see Abstr. 3927 of 1955). A family of continuous circular aperture distributions is developed in such a way as to involve only two independent parameters, A, a quantity uniquely related to the design sidelobe level and $\bar{n}$ a number controlling the degree of uniformity of the sidelobes. An asymptotic approach to the condition of uniform sidelobes thus becomes possible. A companion article contains aperture distribution tables and examples.

621.396.677.7

6378 TABLES OF TAYLOR DISTRIBUTIONS FOR CIRCULAR APERTURE ANTENNAS. R.C.Hansen.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 23-6 (Jan., 1960).

Tables of the circular aperture distributions described in the preceding paper are given. Steps in the design process are illustrated by examples.

621.396.677.71

6379 A SLOT WITH VARIABLE COUPLING AND ITS APPLICATION TO A LINEAR ARRAY. R.Tang.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 97-101 (Jan., 1960).

The importance of a waveguide linear array capable of producing many different radiation patterns has led to the development of a slot radiator with variable coupling. An array of such radiators can be used as a laboratory apparatus for the evaluation of aperture distributions, or as a ground-painting reconnaissance aerial operable at many different altitudes. The slot radiator consists of a longitudinal slot centred in the broad face of a rectangular waveguide. An adjustable iris excites the slot by introducing controlled asymmetry in the waveguide fields. The theory of operation and the characteristics of this variable coupling slot are presented. These characteristics are shown in curves usable for design purposes. A detailed discussion is given of the technique used in determining the range of conductances of this slot. The control of coupling available is demonstrated by measured radiation patterns on a 12-element array

in which the conductance values are varied to obtain sidelobe ratio from 10 to 34 dB. The method used in obtaining the aperture distributions for these radiation patterns is also presented.

621.396.677.73 : 621.396.96

6380 PRECISION TRACKING WITH MONOPULSE RADAR. J.H.Dunn and D.D.Howard.
Electronics, Vol. 33, No. 17, 51-6 (April 22, 1960).

The monopulse system uses a four-horn feed to the aerial and by combining signals from the four horns an extremely high lobe-switching rate can be achieved. Advantages of this system when compared with sequential lobing and conical scan are discussed.

C.A.Hogarth

621.396.677.8

6381 TRANSMISSION-LINE MISSILE ANTENNAS. R.King, C.W.Harrison, Jr and D.H.Denton, Jr.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 88-90 (Jan., 1960).

A class of protruding rocket aerials of low silhouette is analysed in terms of an approximately equivalent circuit that consists of a shunt-driven transmission line terminated in a reactor at each end. Expressions for the currents in the several parts of the circuit are used to determine the Poynting vector and from this the radiation resistance referred to the current in the generator. The reactance is obtained from transmission-line formulae.

621.396.677.8

6382 MODIFIED LUNEBERG LENS FOR DEFOCUSED SOURCE. D.K.Cheng.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 110-11 (Jan., 1960).

A spherical Luneberg lens has the property of focusing the rays from a point source on the surface of the lens into a collimated beam on the diametrically opposite side of the lens. In microwave applications a point source on the surface of the lens is usually not obtained. Curves are given for the required index of refraction for a modified Luneberg lens which possesses the same collimating property for a point source located at a small distance outside of the lens.

621.396.677.832

6383 A SLOT-EXCITED CORNER REFLECTOR FOR USE IN BAND V (610-960 Mc/s). D.J.Whythe and K.W.T.Hughes.
Proc. Instn Elect. Engrs, Paper 3303 E, publ. Sept., 1960 (Vol. 107B, 431-4).

The directional aerial described employs a corner reflector excited by a four-tier slotted cylinder. It was used during a series of test transmissions in Band V (610-960 Mc/s) which required an aerial capable of withstanding severe climatic conditions for long periods without attention. A design suitable for operation at 900 Mc/s is described; the measured results include admittance characteristics and radiation patterns in the horizontal and principal vertical planes.

621.396.677.833.1

6384 THE CALCULATION OF REFLECTOR ANTENNA POLARIZED RADIATION. L.E.Raburn.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 43-9 (Jan., 1960).

A partly analytical process is described for calculating the far-zone patterns of reflector aerials which may have nonlinear polarization. Wave polarization equations are given for a focused but not necessarily symmetrical paraboloid. The process applies for any point-source feed whose radiation characteristics, including wave polarization, are known either by theory or measurements. Calculated and measured paatterns are given for a fan-beam aerial whose reflector is 120λ high and 30λ wide. They agree well near the axis and agree qualitatively for off-axis angles of several beam-widths. The sources of errors are discussed.

621.396.677.833.2

6385 GROUND ANTENNA FOR SPACE COMMUNICATION SYSTEM.
K.W.Linnes, W.D.Merrick and R.Stevens.
I.R.E. Trans Space Electronics and Telemetry, Vol. SET-6, No. 1, 45-54 (March, 1960).

An 85 ft diameter, equatorially mounted, parabolic reflector for satellite tracking is described. The aerial, similar to those used for radio astronomy, is located near Goldstone Lake near Barstow, Calif. The mechanical and electrical characteristics and subsystems are discussed, and performance in tracking the lunar probe Pioneer IV is described. Limitations imposed on the space communication system by the ground aerial are discussed, and possible methods of improvement are listed.

621.396.677.85

6386 ARTIFICIAL MICROWAVE DIELECTRIC FOR A SIMPLE APLANAR LENS; MEASUREMENT TECHNIQUES AND TECHNOLOGY. J.Kudrnáč.
Slaboproudy Obzor, Vol. 21, No. 6, 352-7 (1960). In Czech.

The dielectric is produced by employing the printed circuit technique. A base place of "high-pressure" polystyrene is covered with Al foil having a thickness of 10 μ. The unwanted portions (strips) of the foil are removed by etching, so that finally the plate is covered with equidistantly spaced identical squares of foil. A number of such plates are fastened together by means of an epoxy resin, so that the metal squares are directly under each other. An artificial dielectric having the refractive index n = 1.62 is thus formed. The electric characteristics of the material were measured by the phase method. The following parameters were investigated: dependence of n on frequency, n as a function of the lateral displacement of individual plates, and n as a function of the polarization and the angle of incidence of the wave. The results are given in four tables.

R.S.Sidorowicz

PROPAGATION . INTERFERENCE

621.391.812

6387 FREQUENCY SCINTILLATIONS OF SATELLITE SIGNALS BEFORE AND AFTER THE ARGUS EXPERIMENTS. P.R.Arendt.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 73-7 (Jan., 1960).

Satellite signals are effected by frequency scintillations in the same manner as radio star emissions. Therefore, the Doppler shift of such signals suffers fluctuations. These alterations are a function of the variations of the electron density distribution along the radio-ray path under observation. The number and the magnitude of these scintillations are used to measure the roughness of the ionosphere (formation of a scintillation index). The alteration of the established scintillation index during a time interval in August and September, 1958, i.e., before, during, and after the well known Argus experiments is discussed. The observations indicate that no long-living ionospheric inhomogeneities were produced within the zones of the ionosphere which could be checked from our ground station.

621.391.812 : 538.56 : 551.5

6388 V.L.F. ATTENUATION FOR EAST–WEST AND WEST–EAST DAYTIME PROPAGATION USING ATMOSPHERICS. W.L.Taylor.
J. geophys. Res., Vol. 65, No. 7, 1933-8 (July, 1960).

Daytime attenuation characteristics were computed by comparing the amplitude spectra of atmospheric waveforms recorded at four widely separated stations. The results of these attenuation measurements are presented for the band of frequencies from 3 to 30 kc/s and involving distances of 1000 to 10 000 km. Nonreciprocity is evident from this study. Attenuation rates over sea water for east-to-west propagation were about 3 dB/1000 km greater for frequencies below 8 kc/s, and about 1 dB/1000 km greater for frequencies above 10 kc/s, than for west-to-east propagation. East-to-west attenuation rates over land were about 1 dB/1000 greater than for over sea water.

621.391.812.32 : 538.56

6389 RHYTHMIC FADING OF SHORT-WAVE RADIO SIGNALS. B.N.Singh and R.L.Ram.
J. atmos. terrest. Phys., Vol. 16, No. 1-2, 145-55 (Oct., 1959).

The problem of periodic fading due to interference of a number of components of a sinusoidal radio signal has been theoretically treated by considering it as equivalent to determining the resultant of a number of simple harmonic vibrations of nearly equal frequencies. The practical bearing of the results so obtained to fading curves of magneto-ionic origin particularly those caused by interference of three and four components has been discussed. A number of typical fading curves for short-wave radio signals transmitted from Delhi and Calcutta have been described. Particular reference may be made to curves which are very likely of magneto-ionic origin and depict the complete sequence of events expected when the value of

the m.u.f. for the F2-layer passes across the signal frequency due to the increase or decrease of the ionic density of the layer. Fading curves which have been ascribed to interference between waves singly and doubly reflected from the F2-layer and also those which are apparently caused by interference between waves simultaneously reflected from F2- and E-layers have also been described and their features discussed. An example has also been given of such fading curves whose origin appears to be obscure.

621.391.812.44

6390 SUNSPOT-CYCLE VARIATIONS IN THE DISCREPANCIES BETWEEN PREDICTED AND OBSERVED FREQUENCIES FOR USE IN RADIOCOMMUNICATION.
R.J.Hitchcock, G.O.Evans and R.Naismith.
Proc. Instn Elect. Engrs, Paper 3285 E, publ. Sept., 1960 (Vol. 107B, 423-6).

A marked variation occurs over the sunspot cycle in the discrepancies between predicted F2-4000 km m.u.f. and the observed times of fade-in and fade-out on an 18.4 Mc/s Bombay—London circuit. This is particularly marked in summer and is attributed to the influence of the sporadic-E layer, although there is no marked sunspot-cycle effect attributed to this layer. Any assessment of the accuracy of predictions analysed on the assumption of F-layer propagation must be considered in relation to the phase of the sunspot cycle to which it refers.

621.391.812.61

6391 THE TRANSMISSION OF SIGNALS DURING STORMS. V.A.Baranul'ko.
Radiotekhnika, Vol. 15, No. 6, 18 (June, 1960). In Russian.

Some general remarks, including a reference to Soviet experimental work with radiodirection-finders on 50-200 Mc/s at distances up to 600 km. F.Quelon

621.391.812.61

6392 EXPERIMENTAL STUDIES OF METEOR ECHOES AT 200 MC. J.L.Heritage, S.Weisbrod and W.J.Fay.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 57-61 (Jan., 1960).

Describes experimental results of bistatic studies of meteor echoes at 200 Mc/s using a high-power source and highly directive aerials. The transmission paths studied ranged from 940 to 1800 km in length and included many off-great-circle paths. Diurnal burst-rate curves are given for each path. Median duration of the v.h.f. bursts is compared with theory. For certain paths, duty cycle and Doppler shift data are given. At some sites signals were received from ionization aligned with the Earth's magnetic field.

621.391.812.62

6393 TROPOSPHERIC FIELDS AND THEIR LONG-TERM VARIABILITY AS REPORTED BY T.A.S.O. P.L.Rice.
Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1021-9 (June, 1960).

Presents data from long-term recordings of radio field strength over a large number of propagation paths, and presents curves for predicting field strength over a smooth earth for frequencies between 40 and 1000 Mc/s. The basic data provided for the Television Allocations Study Organization during 1957 and 1958 include recordings made in several parts of the world and over various types of terrain and were supplied by numerous sources.

621.391.812.624

6394 DATA TRANSMISSION TESTS ON TROPOSPHERIC BEYOND-THE-HORIZON RADIO SYSTEM.
F.E.Willson and W.A.Runge.
I.R.E. Trans Commun.Syst., Vol. CS-8, No. 1, 40-3 (March, 1960).

Presents the results of data transmission tests made on both single-link and multi-link tropospheric beyond-the-horizon radio systems. Tests were made at 750 and 1300 bits/sec employing both double-sideband a.m. and f.m. methods of data modulation. In the single-link tests the data performance was determined for various transmission parameters such as median channel noise, peak channel noise, radio received carrier level, and order of diversity. Data were satisfactorily transmitted on a 2400 mile circuit consisting of nine different beyond-the-horizon paths and six line-of-sight paths. The f.m.-type data modulation was notably superior to the a.m. type.

621.391.812.624

6395 THE SUM OF LOG-NORMAL PROBABILITY DISTRIBUTIONS IN SCATTER TRANSMISSION SYSTEMS. L.F.Fenton.
I.R.E. Trans Commun. Syst., Vol. CS-8, No. 1, 57-67 (March, 1960).

The long-term fluctuation of transmission loss in scatter propagation systems was found to have a logarithmic-normal distribution. In other words, the scatter loss in decibels has Gaussian statistical distribution. Therefore, in many important communication systems (e.g., f.m.), the noise power of a radio jump, or hop, has log-normal statistical distribution. In a multihop system, the noise power of each hop contributes to the total noise. The resulting noise of the system is therefore the statistical sum of the individual noise distributions. In multihop scatter systems and others, such as multichannel speech-transmission systems, the sum of several log-normal distributions is needed. No exact solution to this problem is known. An approximate solution is presented which is satisfactory in most practical cases. For tactical multihop scatter systems, a further approximation is proposed, which reduces significantly the necessary computation. An example of the computation is given.

621.391.812.624

6396 PECULIARITIES AND SEASONAL VARIATIONS OF TRANSEQUATORIAL BACKSCATTER ECHOES AS OBSERVED AT MAYAGÜEZ, PUERTO RICO. B.Dueno.
J. geophys. Res., Vol. 65, No. 6, 1691-8 (June, 1960).

As a result of a backscatter experiment on 21.6, 40.68, and 49.68 Mc/s, it has been observed that long-range transequatorial echoes, which are most prevalent during the equinoxial periods, also exhibit a minimum of transequatorial activity during the solstitial periods June, July and December, January. The mechanism for the production of long-range transequatorial echoes (L.R.T.E.) is not well understood. Comparison of data with National Bureau of Standards propagation predictions suggests that the echoes may result from the combined action of the evening equatorial bulge and sizeable concentrations in electron density at the north and south edges of the bulge. The large concentration of electron density in the north edge occurs over Bogota and is easily observable in the late evening hours on the 40 and 50 Mc/s channels at slant ranges slightly under 4000 km. From experimental evidence it is deduced that the angle of arrival of L.R.T.E. echoes is quite low and that the propagation mode is such that the wave stays a short fraction of its total path in the ionosphere. From the experimental data it is also anticipated that a 60 Mc/s back-scatter radar would see L.R.T.E. activity for a very small fraction of time. At this point it is well to concede that backscatter results are on the pessimistic side if compared with ordinary one-way transmissions used in communication circuits.

621.391.812.624 : 538.56

6397 DIRECT H.F. BACKSCATTER FROM THE F REGION. H.F.Bates.
J. geophys. Res., Vol. 65, No. 7, 1993-2002 (July, 1960).

Using the records of the oblique-incidence, sweep-frequency (1-25 Mc/s) scatter sounder located at College, Alaska, it was shown that a commonly observed winter daytime echo was direct scatter from a patch of field-aligned F-region irregularities. The range of this particular echo was constant with frequency out to its junction with the least-time-path echo. Because it was not enhanced by any type of focusing mechanism, it was termed a strong-scatter echo. A series of records for December 16, 1958, are shown and discussed in detail. The behaviour of the strong-scatter F-region echo and another F-region direct-scatter echo during the transitional periods of sunrise and sunset indicates that the field-aligned irregularities are distributed randomly over wide areas at night but that during the day they exist only in relatively small patches. From this it is inferred that the sun has a smoothing effect on the ionosphere.

621.391.812.624 : 551.5

6398 THE SCATTERING OF 36 Mc/s RADIO WAVES BY WEAL AURORAL IONIZATION.
J.S.Greenhow, E.L.Neufeld and C.D.Watkins.
J. atmos. terrest. Phys., Vol. 18, No. 2-3, 174-80 (June, 1960).

Some observations of weak back-scatter echoes similar in type to the echoes associated with visual aurorae are described. With an equipment of high sensitivity at a frequency of 36 Mc/s, these echoes are present to the north of Jodrell Bank (lat. 53°N, geographic; lat. 56°N, geomagnetic) for up to 30% of the observing time. The irregularities in ionization, which are aligned along the earth's magnetic field, have a length scale of 160 m and a scattering polar diagram with a width of approximately ±3°. The horizontal dimensions of the ionized regions are about 500 km along parallels of geomagnetic latitude, and 50 km at right angles to this direction. Echoes from horizontal layers of ionization, associated with the field aligned irregularities, are also observed.

621.391.812.63 : 550.3

6399 REFLECTION OF MICRO-WAVES FROM EARTH'S SURFACE. A.C.De.

Indian J. Meteorol. Geophys., Vol. 11, No. 1, 45-9 (Jan., 1960).

Interesting examples of coefficient of reflection from flat ground (aerodrome runway) are described. These observations indicate the satisfactory performance of the radar set installed at Dum Dum airport for meteorological purposes. Different aspects of the occurrence of reflection phenomenon are discussed and a review of work in other countries is also made.

621.391.812.63 : 538.56

6400 ANALYSIS OF IONOSPHERIC PATHS IN LONG-RANGE PROPAGATION. H.J.Albrecht.

Indian J. Meteorol. Geophys., Vol. 11, No. 1, 57-63 (Jan., 1960).

Describes new theoretical and technical methods of measuring and evaluating propagation paths over large distances. A detailed treatment is given of analysis by attenuation measurements and path diagrams together with essential aspects of ionospheric path recorders. Reference is made to modernized design and transistorization.

621.391.812.63 : 551.5

6401 SCATTERING OF RADIO WAVES BY ELECTRONS ABOVE THE IONOSPHERE. E.E.Salpeter.

J. geophys. Res., Vol. 65, No. 6, 1851-2 (June, 1960).

See Abstr. 554 of 1959. If α is the ratio of radio wavelength to $4\pi D \sin\frac{1}{2}\theta$, where D is the electron Debye length and θ the scattering angle, then the frequency spectrum of scattered radar waves shows interesting features when α is comparable with unity. With the definitions

$$F_\beta(\phi) = \{\exp(-\tfrac{1}{2}\phi^2)\}/\{\tfrac{1}{2}\pi\beta^2\phi^2\exp(-\phi^2) + [1 + \beta^2 - \beta\sqrt{\pi}f(\phi/\sqrt{2})]^2\}$$

$$f(x) = 2x\exp(-x^2)\int_0^x \exp t^2\,dt,$$

the function $F_\beta(\phi)$ represents the shape of the frequency spectrum of the "electron component" of the scattered wave, if $\beta = \alpha$ and $\phi = c(\omega-\omega_0)/v_e\omega_0 2\sin\frac{1}{2}\theta$. Here ω and ω_0 are the frequencies of scattered and incident radiation, c the velocity of light and v_e the mean thermal electron velocity. If the ions are singly charged $F_\beta(\phi)$ also represents the shape of the "ion component" spectrum with the substitution of v_i for v_e in the above expression for ϕ and with $\beta = \alpha(1+\alpha^2)^{-1/2}$. Suggestions are made for possible evaluation of experimental backscatter spectra. D.M.Gilbey

621.391.812.63 : 551.5

6402 THE SIZE OF THE MOVING IRREGULARITIES IN THE F-REGION AND THE SPREAD ANGLE OF THE RADIO WAVES SCATTERED FROM THEM. S.R.Khastgir and R.N.Singh.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 123-6 (June, 1960).

The three-spaced-receiver fading records of the F-echo at 3.8 Mc/s, taken at Banaras during the period from November 1956 to September 1958 show certain characteristic patterns. The fading patterns which were considered as due entirely to the movement of large ionospheric irregularities are analysed by the method of Briggs and Phillips [Proc. Phys. Soc. (London) B, Vol. 63, 907-23 (Nov., 1950)]. As a result of this analysis the average characteristic length of the irregularities is found to be 270 m and the average angular spread is found to be 6°. The variations of these parameters are shown with the help of histograms. The records show some diurnal and seasonal variations, but no definite conclusion can be made regarding such variations.

621.391.812.63

6403 VERTICAL DISTRIBUTION OF THE SCATTERING PARAMETER FOR RADIO WAVE.

K.Hirao, K.Akita and I.Shiro.

J. Radio Res. Lab. (Tokyo), Vol. 6, 595-601 (July, 1959).

Measurements of the mean wind velocity and of variations of the refractive index were made at 100 m intervals up to a height of 1000 m, captive balloons being used to support the hot-wire anemometer and thermistor type of refractive-index variometer. The measurements were made at the Tateno Aerological Observatory during September, 1957, and November, 1958. The results obtained indicate that the scale of the irregularities of the refractive index is independent of the height, and that the scattering parameter is inversely proportional to the 2/3 power of the height during the daytime and almost constant during the night. The value of the scattering parameter in November, 1958, was only about half that in September, 1957. A.Wilkinson

621.391.812.63

6404 A POSSIBILITY OF THE LONG DISTANCE H.F. PROPAGATION ALONG THE EXOSPHERIC FIELD-ALIGNED IONIZATIONS. T.Obayashi.

J. Radio Res. Lab. (Tokyo), Vol. 6, 603-12 (July, 1959).

A fixed-frequency backscatter sounder, with a rotating directional aerial and a range/time scope display of the data, has been operated at Hiraiso since the summer of 1958. The transmitter operates on 27.12 Mc/s with 100 μsec pulses at repetition rates of 50, 25 and 12.5 per sec, the equivalent ranges being 3000, 6000 and 12 000 km respectively. Typical records are reproduced and the results obtained are discussed, a ray treatment of the propagation along a path with field-aligned ionization being given. Backscattering echoes with ranges of the order of 3000-4000 km were found to occur at almost all hours of the day. Exceptionally long-range echoes, with ranges of the order of 7500 km, were observed mostly from a southerly direction in the evening hours. The violent fading of the echoes appears to suggest an unusual scattering mechanism differing from the usual F-layer reflections. The echo distance to be expected from the ray treatment of propagation between geomagnetically conjugate points, along the exospheric field-aligned ionizations, is the same as the average range of the observed transequatorial echoes. It is also found that the average exospheric electron density deduced from the observed echo spreads is about 10^6–10^8 electrons per cm^3. A possible use of this propagation mode of backscatter as a tool for exospheric sounding is suggested. A.Wilkinson

621.391.812.63

6405 EXPERIMENTAL PROOF OF FOCUSING AT THE SKIP DISTANCE BY BACKSCATTER RECORDS. K.Bibl.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 956-7 (May, 1960).

For more than half a year, backscatter records have been made at Breisach am Rhine on a fixed frequency of 16.65 Mc/s, using a pulse duration of 100 μsec. The records, of which typical examples are reproduced, show clear evidence of focusing on nearly every day, often for many hours and for both magneto-ionic components. The effect of focusing was less pronounced in summer than in winter, and at Breisach the focusing phenomena were less frequent and less important when observations were made in the directions of 250° and 280° than they were in the 220° direction. A statistical analysis of the results for the first 6 months of 1959, for the S. and S.W. directions, is given in a diagram which shows the degree of focusing observed each day in the periods morning, daytime, evening and night, the focusing being classified into four grades:- 0 = no focusing; 1 = weak focusing; 2 = both components distinctly visible at skip distance; 3 = lasting a long time and components distinctly visible. On the frequency used, daytime focusing was only present in winter and night focusing was most frequent in spring. The over-all importance decreased in summer. A.Wilkinson

621.391.812.631

6406 REFRACTION OF V.H.F. SIGNALS AT IONOSPHERIC HEIGHTS. S.Weisbrod and L.Colin.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 107-9 (Jan., 1960).

It is not generally realized that while the refractive error due to the troposphere rapidly decreases with the elevation angle, its ionospheric counterpart behaves very differently. For target heights which are small or comparable to the Earth's radius the ionosphere refractive error initially increases with the elevation angle, attains the maximum value at elevation angles on the order of 100 milliradians and then gradually decreases. The size of this increase decreases with the distance from the Earth and at astronomical distances the initial slope of the ionospheric error at grazing incidence is zero. At ionospheric heights the elevation angle at which the ionospheric bending is maximum is roughly proportional to the square root of the layer height. This somewhat unexpected behaviour of ionospheric bending is examined and sample computations are made using realistic models of ionosphere and troposphere.

621.391.812.632

6407 DISPERSION, ABSORPTION AND POLARIZATION CURVES FOR RADIOWAVE PROPAGATION THROUGH THE IONOSPHERE IN THE PRESENCE OF EARTH'S MAGNETIC FIELD. R.N.Singh and Y.S.N.Murty.

J. sci. Res. Banaras Hindu Univ., Vol. 9(1), 1-18 (1958-59: publ. Dec., 1958).

Absorption, dispersion and polarization curves for normal-incidence radiowave propagation are drawn for the magnetic conditions of the ionosphere above Banaras (latitude 25°N, longitude

83° E, dip angle 36° 26' N, H = 0.446 gauss). These curves are obtained by applying Bailey's method of conformal representation to the Appleton-Hartree formulae and they refer to wavelengths of 30, 200, 240.3 and 400 m and to electron collision frequencies of 0, 10^6, 4.49×10^6 and 10^7 per sec., these being values likely to cover the range of practical importance for radiowave propagation. Curves for both the ordinary and extraordinary magneto-ionic components are drawn, taking into consideration the variation of the earth's magnetic field with the height of the E-layer and the F-layer. The ϕ-curves for polarization are drawn under the assumption that the major axes of the ordinary and extraordinary ellipses are not in general mutually perpendicular, but are such that the sum of their tilt-angles with Y-axis is an odd integral multiple of $\pi/2$. The absorption curves for Banaras show that, for large electron-collision frequencies, the ordinary component is more absorbed than the extraordinary. A.Wilkinson

621.391.812.7 : 621.396.621

6408 V.H.F. SOUND BROADCASTING. SUBJECTIVE APPRAISAL OF DISTORTION DUE TO MULTI-PATH PROPAGATION IN F.M. RECEPTION. R.V.Harvey.
Proc. Instn Elect. Engrs, Paper 3221 E, publ. March, 1960 (Vol. 107B, 412-21, 421-2).

Republication, with discussion, of the paper already abstracted as Abstr. 2525 of 1960.

621.391.814.233

6409 FADING AND ATTENUATION OF HIGH-FREQUENCY RADIO WAVES PROPAGATED OVER LONG PATHS CROSSING THE AURORAL, TEMPERATE AND EQUATORIAL ZONES. K.C.Yeh and O.G.Villard, Jr.
J. atmos. terrest. Phys., Vol. 17, No. 4, 255-70 (Feb., 1960).

This investigation is primarily concerned with the fading and attenuation of high-frequency radio signals propagated over a long path crossing the auroral zone. The fading of high-frequency signals propagated over non-auroral paths of comparable length has also been studied, and some new results are obtained. The principal fading and attenuation measurements on which these conclusions are based were carried out in August 1957. For the auroral paths, there is no diurnal variation in fading speed except for a distinct minimum in time interval 1330-1900 P.S.T., during which time the fading speed has little apparent dependence on magnetic activity along the path. In other time periods a positive correlation between magnetic activity and fading speed is found. It is suggested that the period of minimum fading speed is a consequence of the existence at that time of the kind of propagation mode made possible by ionospheric tilts. Attenuation over the long auroral-zone path is found to be associated with "polar blackouts" as indicated by the absence of returned echo in vertical sounders located along the path. The percentage association varies with the location of the station relative to the path. This variation is consistent with the inferred propagation modes. It is found that during the hours 1330-1900 P.S.T. the attenuation cannot be attributed to the absorption that gives rise to blackouts as it can in the other hours. This is also explainable on the basis of the postulated tilt-mode propagation. Similar observations for temperate-latitude and transequatorial paths of comparable length indicate that there is strong diurnal variation in fading speed. Some plausible explanations are offered.

621.391.82

6410 RADIO-FREQUENCY INTERFERENCE IN THE TD-2 RADIO RELAY SYSTEM. H.E.Curtis.
Trans Amer. Inst. Elect. Engrs I, Vol. 79, 64-70 (1960) = Commun. and Electronics, No. 47, (March, 1960).

The TD-2 system, which uses f.m. and operates in the 3700-4200 Mc/s band, can provide six 2-way broadband channels, each of which can accommodate two 1-way television channels or 480 or more 2-way telephone channels. The various types of interference which may arise in such a system are discussed in detail, long-haul circuits using several repeaters being particularly considered. A.Wilkinson

621.391.821 : 551.5

6411 LIGHTNING DISCHARGES AS A SOURCE OF WHISTLERS. H.Norinder and E.Knudsen.
Ark. Geofys., Vol. 3, Paper 11, 255-88 (1960).

A station for analysis of relations between lightning discharges and whistlers was operated near Uppsala. After preliminary tests in 1956-57 a definite programme was realized during the thunderstorm season of 1958. It was found that whistlers occur in groups — whistler situations — with periods often of ½ to 2½ hr, exceptionally of 5 to 6 hr. Whistlers sometimes occurred in great numbers for shorter periods of time between total cessations. These extended over hours, days and even weeks. Whistler situations on days with thunderstorms were located by a c.r.o. direction finder. It was found that whilst a thunderstorm in one direction produced whistlers, a simultaneous thunderstorm in another direction at about the same distance did sometimes not. Variations in the same thunderstorm of the electric field force from atmospherics related or not to whistlers resulted in that atmospherics with the highest field force were always followed by whistlers. This was explained partially by facilitated propagation for wave-packets in the low-frequency band around 5 kc/s and partially by high initial energy in the discharges causing whistlers. A comparison in the same thunderstorm of wave-forms from atmospherics not producing whistlers showed typically irregular variational forms and one single discharge in the lightning path. On the other hand, whistler-producing lightning discharges very often indicated multiple discharges in the path. By comparative harmonic analysis it was shown that whistler-producing lightning discharges were characterized by a preponderance of frequencies around 5-8 kc/s. Lightning discharges not followed by whistlers distinctly lacked preponderance of values in this frequency region.

621.391.821 : 551.5

6412 MULTIPLE LIGHTNING DISCHARGES FOLLOWED BY WHISTLERS. H.Norinder and E.Knudsen.
Ark. Geofys., Vol. 3, Paper 12, 289-98 (1960).

Time intervals of multiple lightning strokes which produced whistlers were analysed by a cathode-ray oscillograph. The time intervals of the corresponding multiple whistlers were determined by ensuing sonagrams. Within the limits of error a thorough agreement in time intervals is proved. A method is proposed for the analysis of multiple whistlers which originate from separate lightning paths and where whistlers propagate along different ducts.

621.391.821 : 551.5

6413 ATMOSPHERICS FROM LIGHTNING FLASHES WITH MULTIPLE STROKES. E.T.Pierce.
J. geophys. Res., Vol. 65, No. 7, 1867-71 (July, 1960).

The atmospherics resulting from the individual return strokes of a multiple lightning discharge to earth are considered. Special attention is paid to the differences between the source spectra for first and subsequent strokes. It is shown that the change in the velocity of ascent of the return stroke, between a first and a following stroke, implies a shift of the spectrum toward the low-frequency end. On the other hand, the more rapid current rise associated with subsequent strokes entails an intensification of the higher frequencies. A combination of these effects suggests that the source spectrum is effectively constant for all strokes at frequencies exceeding 10 kc/s, and that the main differences occur below this frequency. A straightforward experimental method of checking these conclusions is outlined.

621.391.821 : 551.5

6414 HYPERBOLIC DIRECTION FINDING WITH SFERICS OF TRANSATLANTIC ORIGIN.
E.A.Lewis, R.B.Harvey and J.E.Rasmussen.
J. geophys. Res., Vol. 65, No. 7, 1879-1905 (July, 1960).

The experimental "hyperbolic direction-finder" consists of an array of sferic receivers in the New England area, connected by wide-band data links so that microsecond differences in pulse arrival time can be measured. The hyperbolic directions can be determined from the time differences. In a series of coordinated runs, individual sferics originating in western Europe were observed by both the New England net and the sferics net of the British Meteoroligical Office. The British Meteorological Office furnished the geographic coordinates of the lightning strokes so that measurements of position could be compared. Tabulated results for 150 sferics show an average absolute deviation from the mean of only 31 nautical miles.

621.391.821 : 551.5

6415 SOME MEASUREMENTS OF ATMOSPHERIC NOISE LEVELS AT LOW AND VERY LOW FREQUENCIES IN CANADA. C.A.McKerrow.
J. geophys. Res., Vol. 65, No. 7, 1911-26 (July, 1960).

Atmospheric noise levels at 11, 35, and 135 kc/s were recorded at Ottawa and Churchill for a period of 1 year beginning September 1958. A statistical analysis of the noise as a function of frequency, time of day, and season of the year has shown the following: (1) the same noise storms determine the noise levels received at both

locations (since the beginning of the midday maxima occurs at the same time, whereas local time differs by 1 hour, and the departures of the daily median from the monthly median varies in a regular way and is the same at both locations); (2) the noise level decreases with increase of frequency more rapidly than predicted by C.C.I.R. (especially in winter when the noise storm centres are most distant); (3) the morning decrease in noise level varies in a regular way over the year, as expected from the sunrise time, between the receiver and the location of the most active storm centres; (4) the equipment measures both r.m.s. and the average noise levels. Only at the highest frequency during the winter season is a regular daily variation obtained.

621.391.821 : 551.5

6416 ON THE THEORY OF THE SLOW-TAIL PORTION OF ATMOSPHERIC WAVEFORMS. J.R.Wait.
J. geophys. Res., Vol. 65, No. 7, 1939–46 (July, 1960).

The propagation of the slow-tail portion of atmospherics is considered from the waveguide-mode viewpoint. The source, which is a lightning discharge, is represented by a vertical dipole. The transient response of the distant electric field is then computed for various forms of the source current waveform. The results are then employed to reinterpret the experimental data of Hepburn (J. atmos. terrest. Phys., Vol. 10, 266–87, 1957). As suggested by the present theory it is found that the observed separation t_s between the oscillatory head of the atmospheric and the maximum of the slow-tail amplitude varies with distance ρ to the source according to a law of the form $(t_s)^{1/2} = A + B\rho$. The constant A is related to the pulse width of the source, and the constant B depends on ionospheric parameters. Values of effective ionospheric conductivities deduced from the theory are consistent with earlier results for the v.l.f. band. The influence of nonvertical currents in the discharge channel is also briefly discussed.

621.391.821 : 537.3 : 551.5

6417 AIRPLANE INSTRUMENT FOR MEASUREMENT AND VECTORIAL PRESENTATION OF ELECTRICAL POTENTIAL GRADIENT. B.Vonnegut and D.A.McCaig.
J. geophys. Res., Vol. 65, No. 7, 1959–63 (July, 1960).

Apparatus is described that measures simultaneously all three components of the atmospheric potential gradient and presents the resultant vector on cathode ray oscilloscopes.

621.391.822

6418 EVALUATION OF MESSAGE CIRCUIT NOISE. A.J.Aikens and D.A.Lewinski.
Bell Syst. tech. J., Vol. 39, No. 4, 879–909 (July, 1960).

The reduction and control of message circuit noise requires that its effects be quantitatively characterized. This is achieved by measuring some physical attribute of the electrical noise such that two noises that are judged to be equally interfering are assigned approximately equal numerical magnitudes. To give meaning to such magnitudes, the scale of measurement is related by way of subjective assessment into terms useful to telephone engineering. Pertinent to message circuit noise measurement is the characterization of the relative interfering effect of single-frequency noise components and the way the ear combines these components to indicate the total effect. The correlation between a noise measurement and its associated over-all end-effect may be made by finding the transmission-loss equivalent of the noise being measured or by the direct application of telephone-user opinions expressing degree of transmission satisfaction. In addition to these topics, certain engineering aspects of noise evaluation are discussed.

RADIO APPLICATIONS . RADAR

621.396.93

6419 SOME CONSIDERATIONS OF MEASUREMENTS OF BEARINGS OF THE INCOMING SHORT WAVES. I.Kasuya.
Rep. Ionosphere Res. Japan, Vol. 9, No. 1, 45–9 (March, 1955).

Measurements of the arrival directions of standard 4 Mc/s transmission from Koganei, Tokyo, were made at 4 radio-wave monitoring stations (Kushiro, Sendai, Iwaoka and Miyakonojo) during February 1–7 and March 18–24, 1954. The results obtained are shown graphically and indicate that when the receiving station is within the skip zone, the direction-finding service is beset with difficulties owing to scattered waves being received. The range of variation of the bearings of the incoming waves has a fairly positive correlation with the ratio of the frequency used to the M.U.F. The lateral deviation of a sky wave propagated over short distances may be interpreted in terms of the direction of the circuit relative to the direction of the inclination of the surface of equal electron density in the ionosphere, which tilts appreciably for the wave concerned at twilight or in case of disturbances. A model illustrating this relation between arrival bearing and tilt of the equal-electron-density surface is described and illustrated by several examples.
A.Wilkinson

621.396.933.1 : 681.142

6420 A CATHODE-RAY-LABELLED PLAN DISPLAY. N.J.Smith and P.F.Heggs.
Proc. Instn Elect. Engrs, Paper 3246 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control] (Vol. 107B, Suppl. 19, 54–7, 63–5).

Republication, with discussion, of the paper already abstracted as Abstr. 3135 of 1960.

621.396.933.2

6421 A STATISTICAL ANALYSIS OF CROSS-TRACK ERRORS IN A NAVIGATION SYSTEM UTILIZING INTERMITTENT FIXES. H.Staras and R.W.Klopfenstein.
I.R.E. Trans Aeronaut. Navig. Electronics, Vol. ANE-7, No. 1, 15–19 (March, 1960).

A model is developed relating navigational instrument errors to the actual cross-track error of an aircraft. At a set of equispaced points, fixes on precisely known landmarks are obtained whose accuracy is assumed independent of the length of the flight. An optimum procedure is developed for utilizing these fixes to calibrate the compass on board the aircraft. Finally, the accuracy of arriving at a predetermined destination after the last checkpoint is evaluated. Because of the complexity of the problem, numerical calculations were made on an I.B.M. 650. Two interesting conclusions were reached: (1) for a fixed spacing between fixes the accuracy of arriving at the destination is improved as the length of the flight (and therefore the number of fixes taken) is increased; and (2) for a fixed length of flight, the accuracy of arriving at the destination is almost independent of the number of fixes.

621.396.933.2

6422 INFRARED SEARCH-SYSTEM RANGE PERFORMANCE. R.H.Genoud.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1581–6 (Sept., 1959).

A calculation of the maximum range at which a given object can be detected by an infrared detection system. The factors to be considered include the sensitivity of the detector, the noise generated by the detector and the false signals emitted by the background. Expressions are given for the range under certain limiting conditions.
C.Hilsum

621.396.933.2

6423 AN AUTOMATIC RADIO TRIANGULATION SYSTEM. R.F.Cleaver, P.Sothcott and F.J.Robinson.
Proc. Instn Elect. Engrs, Paper 3243 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control] (Vol. 107B, Suppl. 19, 22–32, 32–5).

Republication, with discussion, of the paper already abstracted as Abstr. 3136 of 1960.

621.396.933.22

6424 SOME PROBLEMS OF DIRECTION FINDING OF INTERFERING RADIO WAVES. Yu.A.Erukhimovich.
Radiotekhnika, Vol. 15, No. 6, 62–6 (June, 1960). In Russian.

The operation of a direction finder with direct reading on a c.r.t. is analysed for a case of reception of two interfering waves. The phenomena of ellipticity, of parallelogram, of wandering bearing and of apparent omnidirectional reception are explained. Practical recommendations are given for improvement of bearing reading.
A.Woroncow

621.396.933.4 : 681.142

6425 A SURVEY OF DATA HANDLING FOR AIR TRAFFIC CONTROL. J.C.Farmer and M.F.Whitney.
Proc. Instn Elect. Engrs, Paper 3241 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control], (Vol. 107B, Suppl. 19, 1–11, 32–5).

Republication, with discussion, of the paper already abstracted as Abstr. 3139 of 1960.

621.396.933.4 : 681.142

6426 AN EXPERIMENTAL SYSTEM FOR AUTOMATIC RADAR TARGET DETECTION AND DIGITAL CODED PLOT EXTRACTION AND TRANSMISSION. G.L.F.Hinckley.
Proc. Instn Elect. Engrs, Paper 3248 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control] (Vol. 107B, Suppl. 19, 36–46, 63–5).

Republication, with discussion, of the paper already abstracted as Abstr. 3140 of 1960.

621.396.946 : 621.398

THE COMMUNICATION PROBLEM OF RE-ENTRANT SPACE VEHICLES. See Abstr. 5907

621.396.946 : 534.22

6427 THEORY OF EQUILIBRIUM ELECTRON AND PARTICLE DENSITIES BEHIND NORMAL AND OBLIQUE HYPERSONIC SHOCK WAVES IN AIR.
C.A.Roberts, W.B.Sisco and J.M.Fiskin.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 102-3 (Jan., 1960).

The quantitative changes in propagation, aerial impedance, radar cross-section, breakdown, and emissivity characteristics resulting from hypersonic plasmas depend on the electrons and heavier particles present. To determine these number densities for normal and oblique shocks, aerothermodynamic theory is applied to relate macroscopic properties on both sides of the shock front by means of the flow conservation equations. Composition and energy of the shocked air at assumed velocities, densities, and temperatures are then obtained using the law of mass action and the principles of statistical quantum mechanics until the conservation equations are satisfied.

621.396.96

6428 A MULTIPURPOSE RADAR TARGET.
J.W.Carr.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 7-10 (Jan., 1960).

Consideration of methods of simulating a moving target by making a mechanically stationary target appear (to an m.t.i. equipped radar) to be moving resulted in the use of crystals as switching elements in a low-voltage low-energy battery-powered device. Extending the use of these switching elements results in a target that is visible to any polarization. By applying these concepts to composite waveguide structures, a dual-band simulated target head was developed and field tested.

621.396.96 : 523.16

6429 MAXIMUM ANGULAR ACCURACY OF TRACKING A RADIO STAR BY LOBE COMPARISON. R.Manasse.
I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 50-6 (Jan., 1960).

A general expression is derived for the maximum angular accuracy of tracking a radio star by lobe comparison (or monopulse). This angular accuracy depends on the input signal-to-noise ratio, the wavelength, the time–bandwidth-product of signal integration, and the effective length of the aerial aperture. The maximum angular accuracy can be obtained, approximately, by performing a simple correlation of odd and even components of the aerial output. Angular accuracy formulae for simple dishes or for interferometers appear as special cases of the general result. An appendix discusses the interferometer technique in more detail, and the angular accuracy for the data processing technique used by Ryle Abstr. 2359 A of 1952; (Proc. Roy. Soc. A, Vol. 211, 351-75, March 6, 1952) is compared with that obtained from the optimum processing.

621.396.96

6430 A HISTORICAL SURVEY OF RADIO AND RADAR AIDS TO AIRCRAFT NAVIGATION. R.G.Hart.
J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 409-15 (June, 1960).

A review of the application of radio to navigation in the Royal Air Force.

621.396.96

6431 FUTURE TRENDS OF RADIO AND RADAR NAVIGATION. C.Williams.
J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 417-28 (June, 1960).

Compares the requirements for marine and aeronautical navigation. Distance–bearing, hyperbolic, and radio Doppler methods are considered. The new techniques of navigation discussed are inertial, mobile high stability sources, very low radio frequencies, radio telescopes and earth satellites. Systems for berthing ships and landing aircraft during bad visibility are described. Some proposals for automation in air traffic control are presented.

621.396.96

6432 APPLICATION OF CORRELATION METHOD IN RADAR TECHNIQUE. F.Klempfner.
Nachrichtentechnik, Vol. 9, No. 11, 507-11 (Nov., 1959). In German.

Gives block diagrams of methods for improving signal/noise ratio by comparing reflected signal with (a) a signal derived from the transmitted signal, and (b) the signal received by a near-by receiver. It is claimed that the limit of recognition of the reflected signal is about 37 dB below the transmitted signal, based on theoretical grounds. No comparison with experiment is given.
N.Corcoran

621.396.96

6433 RADAR TARGET CLASSIFICATION BY POLARIZATION PROPERTIES. J.R.Copeland.
Proc. Inst. Radio Engrs, Vol. 48, No. 7, 1290-6 (July, 1960).

The polarization properties of radar targets are studied as a parameter related to, but quite distinct from, echo area. It is found that targets are divided into several different classes. The polarization properties may be measured by rotating a linearly polarized radar aerial around the line of sight, and measuring the complex voltage presented at the receiving aerial terminals. It is shown that the polarization properties of any target so measured can be represented by a 3-parameter model (excluding echo area), and the parameters of such a model can be used as the basis for discriminating between targets of the same or different classes.

621.396.96

6434 MICROWAVE LINES AND CENTIMETRE MEASURING TECHNIQUES FOR RADAR STATIONS. H.Marek.
Slaboproudy Obzor, Vol. 21, No. 6, 345-52 (1960). In Czech.

This survey deals briefly with the characteristics of microwave transmission lines (waveguides) and the measuring devices employed in the testing and maintenance of radar equipment. It is shown that the design of a transmission waveguide is based on the following considerations: (1) line losses due to the finite conductivity of the walls, radiation and mismatch; (2) maximum transmitted peak power; (3) effect of the line on the functioning of the transmitter valve. The measuring equipment consists of: (1) standing-wave ratio and power meters, (2) frequency meters, and (3) pulse spectrum analysers. The equipment is based on such devices as waveguide junctions, aerial switches (TR tubes), mixers, detectors, cavity resonators, waveguide sections and thermistor bridges. R.S.Sidorowicz

621.396.962.23

6435 SIGNIFICANCE OF CONSTANT FREQUENCIES FOR C.W. RADAR TECHNIQUES AND ACHIEVEMENT OF A HIGHLY ACCURATE FREQUENCY. W.Herzog.
Nachrichtentech. Z. (N.T.Z.), Vol. 13, No. 1, 29-33 (Jan., 1960). In German.

Requirements of Doppler radars are reviewed and some formulations of frequency stability are given. Stabilization by twin quartz crystals in thermionic-tube circuits, using the crystals as resonant elements or as phase-shifters, and single crystal control of a stabilized transistor circuit, is discussed. Experimental results with a phase-shift valve oscillator gave a stability of 1 in 4×10^{-8} per day whilst the transistor circuit with crystal control gave a figure of 1 in 1.5×10^{-8} per day. 7 references. A.Reiss

621.396.962.3

6436 THE THEORY AND DESIGN OF CHIRP RADARS.
J.R.Klauder, A.C.Price, S.Darlington and W.J.Albersheim.
Bell Syst. tech.J., Vol. 39, No. 4, 745-808 (July, 1960).

A new radar technique has been developed that provides a solution for the conflicting requirements of simultaneous long-range and high-resolution performance in radar systems. This technique, called Chirp, recognizes that resolution depends on the transmitted pulse bandwidth. A long high-duty-factor transmitted pulse, with suitable modulation (linear frequency modulation in the case of Chirp), which covers a frequency interval many times the inherent bandwidth of the envelope, is employed. The receiver is designed to make optimum use of the additional signal bandwidth. Many of the important analytical methods required for the design of a Chirp radar system are given. The details of two signal generation methods are considered and the resulting signal waveforms and power spectra are calculated. The required receiver

characteristics are derived and the receiver output waveforms are presented. The time–bandwidth product is introduced and related to the effective increase in the performance of Chirp systems. The concept of a matched filter is presented and used as a reference standard in receiver design. The effect of amplitude and phase distortion is analysed by the method of paired echoes. One consequence of the signal design is the presence of time side lobes on the receiver output pulse analogous to the spatial side lobes in aerial theory. A method to reduce the time side lobes by weighting the pulse energy spectrum is explained in terms of paired echoes. The weighting process is described, and calculated pulse envelopes, weighting network characteristics and deleterious effects are presented. The effects of quadratic phase distortion are analysed and the resultant pulse envelopes are presented. The receiver response characteristics in the presence of Doppler-shifted signals from moving targets are examined. Schematic ambiguity diagrams are presented for current signal designs. See also following abstract.

621.396.962.3

6437 THE DESIGN OF RADAR SIGNALS HAVING BOTH HIGH RANGE RESOLUTION AND HIGH VELOCITY RESOLUTION. J.R.Klauder.

Bell Syst. tech. J., Vol. 39, No. 4, 809-20 (July, 1960).

A discussion is presented of some fundamental limitations on simultaneous range–velocity determination in terms of ambiguity diagrams, with the aid of a quantum mechanical analogue to the Wigner distribution function. A sequence of signals is found in which the signals yield both range and velocity information with increasing accuracy. However, this desired property is not accompanied by a waveform suitable for maximum operating efficiency.

621.396.963 : 621.317.39 : 612.8

6438 EYE MOVEMENTS DURING SIMULATED RADAR SEARCH. C.T.White and A.Ford.

J. Opt. Soc. Amer., Vol. 50, No. 9, 909-13 (Sept., 1960).

The electrical method of eye-movement recording (the electro-oculogram) was utilized to study visual search behaviour while subjects monitored simulated radar displays. Information was obtained regarding the pattern of search employed, and the spatial distribution and duration of fixations. These factors are discussed in regard to their effect on the detection of targets in displays of this kind.

621.396.963 : 681.142

6439 FIXED-COIL DISPLAY SYSTEM FOR DATA EXTRACTION. W.F.Ashton.

Proc. Instn Elect. Engrs, Paper 3245 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control](Vol. 107B, Suppl. 19, 58-63, 63-5).

Republication, with discussion, of the paper already abstracted as Abstr. 3141 of 1960.

621.396.963.325 : 612.8

6440 PROBLEMS OF VISION IN A P.P.I. RADAR FIELD. L.Ronchi.

Atti Fond. Ronchi, Vol. 15, No. 3, 256-9 (May-June, 1960). In Italian.

A general discussion of the factors which affect performance in scanning a radar tube. The best luminance is about 0.1 ft-L and a similar general luminance of the surroundings is advantageous. No new work is reported, but conclusions reached by other investigators are given. J.W.T.Walsh

621.396.965.8 : 681.142

6441 SEMI-AUTOMATIC FLIGHT CONTROL USING EXTRACTED RADAR DATA. C.C.Fielding and J.G.Gibbs.

Proc. Instn Elect. Engrs, Paper 3247 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control] (Vol. 107B, Suppl. 19, 47-50, 63-5).

Republication, with discussion, of the paper already abstracted as Abstr. 3143 of 1960.

621.396.965.8 : 681.142

6442 METHODS OF EXTRACTING RADAR DATA FOR AUTOMATIC PROCESSING.

N.J.Smith and B.W.Oakley.

Proc. Instn Elect. Engrs, Paper 3244 E, publ. March, 1960 [Symposium on Data Handling and Display Systems for Air Traffic Control] (Vol. 107B, Suppl. 19, 51-3, 63-5).

Republication, with discussion, of the paper already abstracted as Abstr. 3142 of 1960.

621.396.968

6443 A PRELIMINARY STUDY OF "ANGEL" ACTIVITY NEAR BOMBAY. D.B.Rai.

Indian J. Meteorol. Geophys., Vol. 10, No. 3, 313-20 (July, 1959).

During the period March-May 1958 some radar angels were observed on the p.p.i. display of a weather radar based at Bombay. These echoes cannot possibly be attributed to the generally accepted type III angel source, viz., reflection of radar waves from ground via atmospheric layers or inhomogeneities. It is suggested that these angels are caused by direct partial reflection from a horizontally stratified layer containing shear-gravity waves.

621.396.969 : 523.16

6444 ROUGHNESS OF THE MOON AS A RADAR REFLECTOR. V.A.Hughes.

Nature (London), Vol. 186, 873-4 (June 11, 1960).

The angular scattering properties of the moon have been measured at a wavelength of 10 cm using the 2 MW radar transmitter in the 45 ft diameter radio telescope at Malvern employing a pulse length of 5 μsec corresponding to a range resolution of 0.75 km. The measured law of scattering is consistent with scattering from a rough surface which has irregularities much greater than a wavelength and a horizontal scale equivalent to about twenty times the vertical deviations. Comparison with sea echoes indicates that the reflectivity if the moon lies between 10^{-1} and 10^{-2}. It is suggested that for other planets the reflectivity is greater and the total scattering area of a planet approximately equal to the projected area. C.Hazard

621.396.969

6445 MEASUREMENTS OF LUNAR REFLECTIVITY USING THE MILLSTONE RADAR. G.H.Pettengill.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 933-4 (May, 1960).

A new method for mapping the source of radar echoes from a distant rotating target has been applied to the moon. An accurate spectral analysis of power density is carried out for each of many range intervals encompassing the extent of the returned signal-frequency and time. A typical set of results is given and shows the presence of substantial echoes out to the limbs, the sharp bends to the spectra set by the geometrical constraints of the moons surface and the concentration of signal at the upper and lower frequency limits at the longer delays, this latter effect being geometrical. A comparison of the relative amounts of diffuse and specular reflection indicates that an average of about 10% of the lunar surface is sufficiently rough at this frequency to exhibit Lambert scattering. C.Hazard

621.396.969

6446 LUNAR ECHOES RECEIVED ON SPACED RECEIVERS AT 106.1 Mc. R.B.Dyce and R.A.Hill.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 934-5 (May, 1960).

Radar echoes from the moon at 106.1 Mc/s were received at two partially mobile receiving stations. Correlation measurements on the received signals at various spacings to a minimum projected baseline of 0.8 km imply that much if not all of the lunar surface is effective in echoing a man-made signal. C.Hazard

621.396.969.182.3

6447 ACCURATE TRACKING FOR RADIO THEODOLITES. F.Ellis.

Electronic Industr., Vol. 19, No. 3, 118-20 (March, 1960).

Describes with the aid of block and part-circuit diagrams the design of equipment to control the azimuth and elevation of the 10 ft. diameter aerial system of a weather sonde tracking radio theodolite. A system static accuracy of 0.01° and a dynamic accuracy of better than 0.03° r.m.s. are achieved. C.A.Hogarth

621.396.969.3 : 523.16

6448 RADAR ASTRONOMY SYMPOSIUM REPORT. R.L.Leadabrand.

J. geophys. Res., Vol. 65, No. 4, 1103-18 (April, 1960).

A symposium was held at San Diego in October 1959, as part of the technical programme of the United States National Committee of the International Scientific Radio Union. The subjects discussed included radar studies of the moon, sun and planets; radar studies of the exosphere and interplanetary medium and radar echoes from meteors and aurorae.

621.396.969.34 : 535.8

6449 OPTICAL-MECHANICAL SCANNING TECHNIQUES. M.R.Holter and W.L.Wolfe.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1546-50 (Sept., 1959).

Various scan patterns are described, and the performance of a prism scanner used in an aircraft is considered in detail. The problems of scanning at very low and very high altitudes are analysed, and the design is given of prism scanners for these applications. C.Hilsum

621.396.969.34 : 535.8

6450 INFRARED SEARCH SYSTEM DESIGN CONSIDERATIONS. R.H.McFee.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1550-2 (Sept., 1959).

The different types of mechanical scanning systems are briefly described and some examples of practical systems are given. C.Hilsum

621.396.969.34 : 538.56 : 535.8

6451 COMBINED OPTICAL–MICROWAVE SYSTEM CONSIDERATIONS. S.H.Cushner.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1553-4 (Sept., 1959).

A short discussion of detecting systems which are sensitive to both infrared radiation and microwaves. C.Hilsum

621.396.969.34 : 536.3

6452 METHODS OF BACKGROUND DESCRIPTION AND THEIR UTILITY. D.Z.Robinson.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1554-61 (Sept., 1959).

The characteristics of the background against which a potential target appears is an important consideration in the design of infrared detection systems. A survey is made of the present methods of describing backgrounds. The backgrounds are classified into various types and the use of the proposed descriptions for each type is examined. It is concluded that the autocorrelation function and the Wiener transform are good means for describing a Gaussian background ensemble, but for non-Gaussian ensembles, such as cloudy skies, these functions give no indication of peak noise signal. The use of the probability distribution of radiance is recommended for non-Gaussian ensembles. C.Hilsum

621.396.969.34 : 535.8

6453 THE TECHNIQUE OF SPATIAL FILTERING. G.F.Aroyan.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1561-8 (Sept., 1959).

Spatial filtering is a method for improving the efficiency of an optical system used for detecting targets. The space filter enhances the salient dimensional features of the target at the expense of dimensional detail received from undesired radiation in the background. It usually consists of a field stop and a reticle located at the focal plane. The reticle is a pattern of opaque and transparent parts, and it can simultaneously scan and modulate the image. After a mathematical analysis and some consideration of background radiation, the design of optimum space filters is described. C.Hilsum

621.396.969.34 : 535.8

6454 OPTICAL FILTERING. L.W.Nichols.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1569-70 (Sept., 1959).

Optical filters can be used in infrared detection systems to reduce the effect of stray radiation from the sun, clouds and similar objects. Some transmission curves are given for suitable filters. C.Hilsum

621.396.969.34 : 536.3

6455 SPECIAL ELECTRONIC CIRCUITS FOR THE NON-IMAGE-FORMING INFRARED SYSTEMS. J.A.Jamieson.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1570-2 (Sept., 1959).

A description of three circuits which are used in infrared detection systems to improve the s/n ratio. They are: (a) a filter with a response matching the time dependence of the expected signal; (b) a system for rejecting background signals; and (c) a circuit which can detect the appearance of an additional target. C.Hilsum

621.396.969.34 : 536.3

6456 SIMULATION OF INFRARED SYSTEMS. H.F.Meissinger.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1586-92 (Sept., 1959).

Theoretical analysis of infrared tracking systems can be supplemented by studies using simulated targets. Simulation techniques can be classified as mathematical or physical, and may involve typically the representation of the complete system in terms of mathematical relations which can be programmed on a computer, the introduction of an electrical signal into the amplifier chain, or the provison of an artificial source of infrared radiation. A survey is given of such techniques, and their application is considered in detail. C.Hilsum

621.396.969.35

6457 THE NAVY'S PORTABLE SATELLITE TRACKING STATIONS. F.M.Ashbrook and D.D.Stevenson.

I.R.E. Trans Space Electronics and Telemetry, Vol. SET-6, No. 1, 41-5 (March, 1960).

The stations described recover Doppler frequencies to an accuracy of one part in 10^9 and subcarrier oscillator frequencies to 15 kc/s bandwidths. Coherent phase detection and a tracking local oscillator to minimize required reception bandwidth maximizes signal sensitivity. Station portability accommodates rapid changes of location as dictated by satellite projects and the flexibility of the receiving and recording equipment due to unitized construction permits inexpensive modifications to accommodate present and future satellite programmes.

TELEVISION

621.397.1

6458 TELEVISION ALLOCATIONS PROBLEMS. E.W.Allen.

Proc. Inst. Radio Engrs, Vol. 48, No. 6 (I), 991-2 (June, 1960).

The Television Allocation Study Organization was established by the television industry in September 1956, at the request of the Federal Communications Commission, to make a thorough analysis of the engineering aspects of problems relating to the television-broadcast allocations. This paper relates the needs underlying the request and gives a brief history of television allocations, culminating in the events leading to the formation of TASO.

621.397.1

6459 THE TELEVISION ALLOCATIONS STUDY ORGANIZATION–A SUMMARY OF ITS OBJECTIVES, ORGANIZATION AND ACCOMPLISHMENTS. G.R.Town.

Proc. Inst. Radio Engrs, Vol. 48, No. 6 (I) 993-9 (June, 1960).

Outlines the objectives and organization of T.A.S.O. and summarizes the more significant findings relating to field-strength measurement and analysis, field tests of television reception, laboratory studies of television picture quality, tropospheric wave propagation, and performance of receiving and transmitting equipment. The performance capabilities of u.h.f. and v.h.f. television broadcasting systems are compared.

621.397.132

6460 VECTORSCOPE - A MONITORING EQUIPMENT FOR THE N.T.S.C. COLOUR STUDIO. H.Schönfelder.

Elektron.Rdsch., Vol. 14, No. 1, 14-18 (Jan., 1960). In German.

After a brief discussion of the two fundamental methods of generating N.T.S.C. colour sygnals in a studio, the need for constant monitoring of amplitude- and phase characteristics of various signals is explained, with the obvious superiority of a visual display. The levels of luminance, Q, I, and sync.burst signals and the phase relationships between the three carriers (Q, I and burst channels) are displayed by a special oscilloscope (Vectorscope); an electronic switch generates periodically three test pulses, which are added to the Q and I signals and to the sync. signals. The combined outputs of these channels are analysed by two synchronous detectors, separated into resistive and reactive components and fed to X- and Y-amplifiers of the vectorscope. A block diagram explains the basic operation of the instrument, illustrated by a number of excellent oscillograms. Typical tests are then described in detail, comprising amplitude and phase checks, the control of correct matrixing (addition of R, G and B signals into Y, Q and I signals), and the adjustment for correct synchronous demodulation. Advice is also given on the test procedure when using a colour-bar generator, and on slave operation of a monitoring scope from the vectorscope output. A.Landman

621.397.132 : 621.376.232

APPLICATION OF SYNCHRONOUS DETECTORS IN COLOUR TELEVISION. See Abstr. 6258

621.397.2

6461 SINE-SQUARED PULSES IN TELEVISION SYSTEM ANALYSIS. R.Kennedy.
R.C.A. Rev., Vol. 21, No. 2, 253-65 (June, 1960).

The development of sine-squared pulse testing as it has occurred in Europe is traced, followed by a comparison of Heaviside step versus sine-squared pulse spectra and their effect on a system. The methods of pulse generation are next presented. The methods of testing various portions of system bandwidths by use of shaped bars, T, and 2T pulses are discussed. Rating factors, time-series computations, envelope delay, and linearity testing are also considered.

621.397.331.2

6462 TELEVISION FIELD SCAN LINEARIZATION. H.D.Kitchin.
J. Brit. Instn Radio Engrs, Vol. 20, No. 5, 357-79 (May, 1960).

Examines conventional linearizing methods and it is shown that the deflection current produced is S-shaped under certain conditions. The deflection current demanded by modern wide-angle cathode-ray tubes is of this form and it is shown that by the correct choice of operating conditions conventional linearizing methods can approximate sufficiently close to the desired shape for normal domestic receiver requirements.

621.397.331.21

6463 SIGNAL GENERATION IN A SUPERICONOSCOPE WHEN SCANNED BY A DOT RASTER. L.I.Khromov.
Radiotekhnika, Vol. 15, No. 6, 45-50 (June, 1960). In Russian.

The dot-scanning process (pulse-amplitude modulation of equal resolution in frame and line direction) is well-known in memory tubes, but the process has not been applied to iconoscopes. A square-wave pulse input will cause a composite signal having a d.c. component, an instantaneous current pulse of secondary electrons, leaving the scanned ("read") element towards unscanned areas of the target, and an instantaneous current pulse of secondary electrons joining the collector. The mechanism of secondary electron movements is discussed and verified experimentally. It is shown that field effects near the target and the primary electron beam jointly produce a retarded secondary electron "cloud", slowly falling back on to the target. The video signal generation and dot scanning of a non-illuminated supericonoscope target are described in detail, with waveform and decay diagrams, showing the generation of positive pulses from the dark target due to the fact that the returning secondary electrons take longer than the scanning period of 10^{-7} sec. "Overlapping" effects due to the rise of the scanning rate and/or scan beam increase are also studied. A.Landman

621.397.331.222

6464 SOME ASPECTS OF VIDICON PERFORMANCE. H.G.Lubszynski, S.Taylor and J.Wardley.
J. Brit. Instn Radio Engrs, Vol. 20, No. 5, 323-34 (May, 1960).

The performance of the 1-in.vidicon is discussed, particularly the effect of various operating conditions on transfer characteristics, lag, resolution and geometry. When target voltage and dark current are high, maximum sensitivity is obtained, but this is at the expense of the other parameters. In the E.M.I. vidicon, the optimum performance as regards γ and lag is obtained for signal currents of 0.2 to 0.3 μA and dark currents of 0.01 to 0.03 μA. Methods of measuring sensitivity, γ and lag are described and possible sources of error indicated. The effect of bias illumination on γ, lag and resolution is analysed. Improvements in geometry are described together with a method of improving resolution. Infrared and ultra-violet sensitive tubes are mentioned.

621.397.335

6465 THE SYNTHESIS OF A FLYWHEEL SYNCHRONIZATION CIRCUIT. S.Vlach.
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 3, 86-93 (Sept., 1959). In German.

The general circuit consists of a phase comparator (discriminator) filter, reactance valve and oscillator. The output of the discriminator is $\mu \sin \varphi$ (where $\varphi = \varphi_1 - \varphi_2$, the latter being the phases of the input and feedback voltages) and is fed to the reactance valve which controls the oscillator, the overall system being described by a differential equation containing also expressions for the feedback-loop gain and reactance-valve sensitivity. This equation cannot be solved unless certain simplifications are assumed, such as stable condition (locked osc.) and linear phase change with control bias. A Laplace transform yields a formula for the output phase in relation to the input phase, which can be used for the construction of amplitude - and transient-response - characteristics of the closed loop system, with various time constants as parameters. Of particular importance is the calculation of an optimal filter which decides if the system is aperiodic, critically aperiodic or a damped oscillatory one; this is discussed in detail. The effect of noise on the system performance is investigated, and the equivalent noise bandwidth is plotted versus filter constants and total loop gain. The pull-in range and its dependence on the transient response is considered next, and nomograms are reproduced, plotting the range versus noise bandwidth, with various system time-constants as parameters. The analysis also considers, throughout, applications to colour-television circuitry (chrominance sub-carrier synchronous detector). A.Landman

621.397.335.12/.22

6466 CALCULATION OF THE TIME CONSTANT IN THE CIRCUIT OF AUTOMATIC BIAS IN PEAK AMPLITUDE OPERATED SYNCHRONIZING PULSE SEPARATOR. A.Ya.Kornienko.
Radiotekhnika, Vol. 15, No. 5, 47-54 (May, 1960). In Russian.

The separation of synchronizing pulses with self-biasing circuits by means of a diode or amplifying valve is analysed and the most suitable time-constants for the circuits are defined. It is shown that circuits with an amplifying valve can work well with much smaller time-constants and larger tolerances than those with a diode. Practical recommendations suitable for Russian television standards are given. A.Woroncow

621.397.6

6467 THE TELEVISION SYSTEM FROM THE ALLOCATION ENGINEERING POINT OF VIEW. R.M.Bowie.
Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1112-21 (June, 1960).

Television allocation is technically dependent upon the properties of the television system comprising, in sequence, the transmitter plant, the propagation path, the receiver plant and the observer. Performance is limited either by receiver noise or by noise and undesired signals entering by way of the receiver aerial. Analysis of this system and its components has led to criteria by means of which service may be defined. These criteria have been incorporated in a procedure for producing maps portraying selected isoservice contours applicable as defining boundaries of the several grades of service. Precision of portrayal is limited essentially by the uncertainty of measurement or prediction of propagation which has led to the use of quasistatistical methods of treatment. Some resulting limitations are pointed out.

621.397.61

6468 REMOTE TV CONTROL BY BLANKING-INTERVAL PULSES. K.Kazama and T.Ishino.
Electronics, Vol. 33, No. 2, 79-81 (May 13, 1960).

Remote control switching, permitting transmission of 6 different instructions by means of pulses sent during frame blanking period is useful for operation of subsidiary television stations. Out of 15 blanked lines 6 can be allocated for the above purposes, and selection of the remote control channel is made by choice of the appropriate delay (0.5 to 2 ms) of a monostable multivibrator. Line sync. pulses time the correct placing to the control pulse within its channel. Block, circuit and waveform diagrams are included. A.Landman

621.397.61

6469 THE SYNC. SEPARATOR STAGE IN THE BLACK AND WHITE TELEVISION TRANSMITTER. G.Coldewey.
Frequenz, Vol. 14, No. 2, 56-8 (Feb., 1960). In German.

After a brief explanation of the need of sync. signal removal after repeated signal manipulation over microwave links and its subsequent re-insertion, the ideal characteristics of a sync. separator are discussed. A simple but efficient circuit of such a stage is then reproduced and described in detail; it consists of a bridge arrangement of four thermionic diodes in the grid circuit of a cathode-follower, with a unidirectional output arrangement. A suitable test signal (staircase waveform) is stripped of sync. without suffering any degradation. A.Landman

621.397.61

6470 SYNC.-SIGNAL REGENERATION SYSTEM FOR LOW-POWER TRANSLATORS. P.K.Kirilloff.
J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 475-7 (June, 1960).

Noise-immune synchronization for fringe-area television reception is discussed. The general lay-out of low-power translators used for expanding regular television reception areas is also considered with a special stress on the sync.-signal restoration circuit.

621.397.61

6471 A MOBILE TELEVISION CAMERA AND RECORDING VEHICLE. A.Harris.

J. Brit. Instn Radio Engrs, Vol. 20, No. 7, 553-9 (July, 1960).

Describes the design and construction of a mobile television camera and recording unit which mounts all the necessary apparatus to televise and record live scenes, even while the vehicle is in motion. The mobile unit contains a television tape recorder, two image orthicon cameras, vision and sound mixing equipment, a synchronizing-pulse generator and a petrol-electric alternator set, as well as miscellaneous accessory equipment. Details are given of vision and sound facilities and power supply system; the mechanical arrangement of the vehicle and equipment mounting is also described.

621.397.61

6472 THE INFLUENCE OF CAMERA OPTICS ON A TELEVISION CHANNEL. D.Frenzel.

Nachrichtentech. Z. (N.T.Z.), Vol. 13, No. 1, 1-8 (Jan., 1960). In German.

Performance of the optical channel is translated into equivalent electrical phenomena i.e. defocusing and other lens aberrations are represented by an equivalent bandwidth and phase characteristic. Measuring methods are described for the determination of such parameters. Different camera lenses were investigated under a number of representative settings and the results are plotted and tabulated. 24 references. A.Reiss

621.397.61

6473 FORECASTING TELEVISION SERVICE FIELDS. A.H.LaGrone.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1009-15 (June, 1960).

The propagation of v.h.f. and u.h.f. television signals over a spherical, irregular surface such as the earth is examined theoretically and experimentally and the principal factors evaluated. The principal factors are found to be frequency, meteorology, terrain and vegetation. It is shown that meteorology, terrain and vegetation vary a significant amount geographically and that local values should be used in forecasting local service fields. The principal factors are included in a new empirical method suggested for forecasting the service fields of television stations. The signal forecast by the new method is compared with field-measured signals with good results.

621.397.61

6474 FINDINGS OF T.A.S.O. PANEL I ON TELEVISION TRANSMITTING EQUIPMENT.

H.G.Towlson and J.E.Young.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1081-7 (June, 1960).

A thorough study was made of the characteristics, performance and cost of television transmitters, aerials and transmission lines, and translators. The results of these studies give a clear picture of the technical and economic factors involved in operating television transmitters in the v.h.f. and u.h.f. bands. Some of these studies are summarized.

621.397.61

6475 PRESENTATION OF COVERAGE INFORMATION. D.C.Livingston.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1102-12 (June, 1960).

Two methods for calculating the locations of boundary contours defining the limits for various grades of television service are described and discussed. The first is the location probability method, which has been used by F.C.C. for allocation and channel assignment operations and the second is the newly developed acceptance ratio method, which emerged from the work of T.A.S.O.

621.397.61

6476 THE STRATOSCOPE I TELEVISION SYSTEM. L.E.Flory, G.W.Gray, J.M.Morgan and W.S.Pike.

R.C.A. Rev., Vol. 21, No. 2, 151-69 (June, 1960).

Stratoscope I is a balloon-borne astronomical telescope designed for solar photography. When aloft, the telescope is remotely operated by radio command signals transmitted from a control station on the ground. A special television system was developed to assist in aiming and focusing Stratoscope I. This equipment comprises a camera and transmitter on the telescope and a ground receiver driving several monitors. It permits the astronomers at the ground control station to aim and focus the telescope visually by inspection of the television monitors. The use of this technique significantly increases the yield of useful photographs obtained.

621.397.62

6477 THE VIDEO PROCESSING CIRCUITS OF AN ALL TRANSISTOR TELEVISION RECEIVER.

C.D.Simmons and C.R.Gray.

I.R.E. Trans Broadcast and Televis. Receivers, Vol. BTR-6, No. 1, 25-32 (May, 1960).

Describes circuits which process the detected video signal and extract from it the various sub-signals required by the receiver. The transistor requirements for these circuits are discussed and recommended transistors and circuits are shown. Performance data and design considerations are included.

621.397.62

6478 TRANSISTORIZED VERTICAL SCAN SYSTEM FOR MAGNETIC DEFLECTION. F.L.Abboud.

I.R.E. Trans Broadcast and Televis. Receivers, Vol. BTR-6, No. 1, 33-8 (May, 1960).

A transistorized vertical deflection system was developed to scan a 90°, 14-in. picture tube at 14 kV accelerating voltage. This system consists of two transistors in a common-emitter multivibrator to form a vertical oscillator, one transistor as a driver and one output transistor, and the system power supply is from a 12-V d.c. source. To prevent decentring of the raster due to the d.c. component of current in the deflection coils, the output stage is coupled to these coils by means of an isolation transformer. Feedback networks are introduced to correct for the non-linear characteristics of the transistors, and to predistort the input waveform to the output transistor in order to compensate for the nonlinearity of the transformer.

621.397.62

6479 RELATIVE PERFORMANCE OF RECEIVING EQUIPMENT AS REPORTED BY TELEVISION SERVICEMEN. H.W.Taylor.

Proc. Inst. Radio Engrs, Vol. 48, No. 6 (I) 1059-65 (June, 1960).

A six-page questionnaire was circulated to television servicemen in communities across the U.S.A. The questionnaire dealt with reception conditions, aerials, transmission lines, receivers and allied questions on both v.h.f. and u.h.f. covering both colour and monochrome. The statistical compilation of answers received is included.

621.397.62

6480 V.H.F. AND U.H.F. TELEVISION RECEIVING EQUIPMENT. W.O.Swinyard.

Proc. Inst. Radio Engrs, Vol. 48, No. 6 (I) 1066-80 (June, 1960).

A study of various types of v.h.f. and u.g.f. television receiving equipment. Information and performance data are given for aerials, transmission lines and television receivers. R.F. amplifier and oscillator electron devices (tubes and semiconductors) used in television tuners for both v.h.f. and u.h.f. are discussed and tables showing relative performance data for devices of various types are included. In addition to this study of home television receiving equipment, studies were made of (1) community television aerial and distribution systems; and (2) the effects of transmitter sound power reduction on television receiver performance. Results of these studies are also included. In general, the data show that performance of v.h.f. equipment is markedly superior to that of u.h.f. equipment and that a reduction in sound power of television transmitters is harmful to television reception, particularly in fringe areas.

621.397.62

6481 I.R.E. STANDARDS ON TELEVISION: METHODS OF TESTING MONOCHROME TELEVISION BROADCAST RECEIVERS, 1960.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1124-54 (June, 1960).

621.397.7

6482 VIDEO-FREQUENCY EQUIPMENT FOR TELEVISION CENTRES OF THE SOVIET UNION. B.A.Berlin.

J. Brit. Instn Radio Engrs, Vol. 20, No. 5, 381-6 (May, 1960).

Details are given of the present state of the television broadcasting network and the proposals for its extension over the next seven years. A brief classification of the equipment for television centres is given in accordance with its programme potentialities. A new television equipment designed for mass production is briefly described. Technical performances of television cameras are discussed and the reasons for certain principles adopted in their design are outlined.

621.397.74

6483 A COMMON CARRIER MULTI-CHANNEL TELEVISION WIRE BROADCASTING SYSTEM.

K.A.Russell and F.Sanchez.

J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 497-512 (July, 1960).

The factors governing the choice and design of a television relay system and the history and background of the development of various systems are surveyed. The basic technical features of a system carrying four television and four radio programmes are discussed. Information is given regarding various types of cable and their specifications. Network jointing and matching fittings are described and the method of using the system characteristics to plan a network is explained with examples and an indication of the sort of coverage that can be obtained. Various types of subscriber installations can be provided and their characteristics are defined and typical examples given of subscriber's equipment. The operation of the main receiving station and repeater equipment is explained in some detail and finally test methods and test equipment are described.

621.397.743

6484 INTERVISION. TECHNICAL PROBLEMS OF THE INTERNATIONAL EXCHANGE OF TELEVISION PROGRAMMES. V.Svoboda.

Slaboproudy Obzor, Vol. 21, No. 5, 258-64 (1960). In Czech.

Intervision is an organization (set up by the O.I.R.T.) for the exchange of television programmes between the following countries: Eastern Germany, Hungary, Poland and Czechoslovakia (later, the U.S.S.R., Rumania and Bulgaria). The organization of the Intervision network is briefly discussed and the requirements to be met by the equipment are indicated. The methods of measurement of the following parameters are discussed: insertion loss and its variation, interference (periodic noise), nonlinear distortion of the video and synchronizing signals, low- and medium-frequency linear distortion of the video signals, and transient response. The characteristics of the transmission channels and of the test signals are indicated in three tables. R.S.Sidorowicz

621.397.8 : 621.317.32

6485 THE MEASUREMENT OF TELEVISION FIELD STRENGTHS IN THE V.H.F. AND U.H.F. BANDS.

H.T.Head and O.L.Prestholdt.

Proc. Inst. Radio Engrs, Vol. 48, No. 6 (I) 1000-9 (June, 1960).

Discusses the details of the T.A.S.O. field-strength measuring specification and describes the programme of field-strength measurements. A summary of the results of the measurements is presented.

621.397.8

6486 THE INFLUENCE OF TREES ON TELEVISION FIELD STRENGTHS AT ULTRA-HIGH FREQUENCIES. H.T.Head.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1016-20 (June, 1960).

Field studies of u.h.f. wave propagation between television transmitting and receiving aerials indicate that typical woods are essentially opaque at these frequencies. The signal in the presence of woods near the receiving aerial appears to be principally that diffracted over the trees, with a small residual "leakage" field observable where the diffracted fields are very weak. The results of measurements are compared with diffraction theory, and the attenuation below free space fields due to the woods is found to be in good agreement with that predicted for a spherical obstacle having a four-thirds earth's radius. The conclusions are applied to the estimation of average losses in large areas.

621.397.8

6487 MEASUREMENTS OF THE SUBJECTIVE EFFECTS OF INTERFERENCE IN TELEVISION RECEPTION.

C.E.Dean.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1035-49 (June, 1960).

A measurement programme was conducted in which almost 200 observers made about 38 000 rating observations on colour and monochrome stationary television pictures impaired by various known amounts of interference. Separate tests were made for the following types of interference: upper adjacent channel, lower adjacent channel, random noise, co-channel with each of six carrier-frequency separations, and simultaneous random noise and co-channel. Six rating grades were used as follows: (1) excellent; (2) fine; (3) passable; (4) marginal; (5) interior; and (6) unstable. The observations were handled on a statistical cumulative frequency basis and plotted on probability paper. Commercial monochrome and colour receivers were used, and the tests were made with laboratory signal-generating equipment on the lower v.h.f. television channels. As representative results, a picture impaired by upper-adjacent-channel interference (with 6 Mc/s channels) was rated by 50% of the observers as passable or better for -27 dB ratio of signal to interference For the lower adjacent case a similar value was found, this result being explained as due to better traps in the medium-high-grade receivers of the test than in many receivers in use by the public. For random-noise interference the requirement for passable or better rating by 50% of the observers was +27 dB on the basis of r.m.s. sync. amplitude to r.m.s. noise over the 6 Mc/s channel. The co-channel tests gave the following requirements for the passable or better rating by 50% of the observers: 22 dB for 360 c/s offset, 41 dB for 604, 24 dB for 9985, 17 dB for 10 010, 29 dB for 19 995 and 17 dB for 20 020. Data for simultaneous co-channel and random-noise interference were taken for 14 combinations of test conditions.

621.397.8

6488 STUDIES OF CORRELATION BETWEEN PICTURE QUALITY AND FIELD STRENGTH IN THE UNITED STATES. C.M.Braum and W.L.Hughes.

Proc. Inst. Radio Engrs, Vol. 48, No. 6(I), 1050-8 (July, 1960).

Presents data which correlates a given level of picture quality with some corresponding level of measured field strength. The data were gathered by actual house-to-house surveys in conjunction with field strength measurements. This procedure was followed rather than making laboratory tests on new receivers because it was desired to evaluate coverage as it actually was, not as it ought to be. Particular attention was paid to differences between u.h.f. and v.h.f. channels with respect to receiver and aerial performance in given field strengths. The ranges of field strengths required for a passable picture quality are fairly well established for each band of television channels.

621.397.9

6489 INDUSTRIAL TELEVISION: A SURVEY OF HISTORY, REQUIREMENTS AND APPLICATIONS. J.E.H.Brace.

J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 441-7 (June, 1960).

621.397.9

6490 APPLICATION OF TELEVISION IN INDUSTRY AND SCIENCE IN THE U.S.S.R. V.I.Sardyko.

J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 449-56 (June, 1960).

CONTROL . DATA PROCESSING

CONTROL AND SERVO SYSTEMS

621-5

6491 ON THE ANALYSIS OF BI-STABLE CONTROL SYSTEMS. B.E.Amsler and R.E.Gorozdos.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 46-58 (Dec., 1959).

The basic theory of bi-stable oscillating loop control is first summarized using standard describing-function concepts. The effective transfer characteristic of the bi-stable switch is defined in terms of the ratio of both amplitude and frequency of the control error signal to amplitude and frequency of the loop oscillation signal. The effect of variation in loop oscillation amplitude with low frequency control error amplitude is considered. The relationship between switch gain at control frequencies and switch gain at oscillation frequency is noted. The inherent insensitivity of the bi-stable oscillating system to variations in linear loop parameters is discussed. The effect of variation in loop gain of the bi-stable system is compared with the effect of equal variations in a similar linear system. The possibility of bi-stable loop oscillation at more than one frequency is considered. The conditions are defined which insure oscillation at the intended oscillation frequency. Analogue simulation tests used to verify these loop oscillation criteria are outlined.

621-52

6492 FUNDAMENTAL THEORY OF AUTOMATIC LINEAR FEEDBACK CONTROL SYSTEMS. I.M.Horowitz.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 5-19 (Dec., 1959).

The reasons for using feedback are reviewed. The beneficial aspects of feedback are quantitatively expressed in sensitivity functions and noise transmission functions. The physical constraints on the controlled process (or plant) determine the maximum number of independent functions realizable. Any configuration with the same number of degrees of freedom may be used. With this approach the study of conditional feedback, model feedback, combined positive and negative feedback, etc. is of secondary interest. The benefits of feedback are paid for in gain-bandwidth of active elements over and above what is needed to physically do the job. The minimum price that must be paid is independent of configuration. The system with two degrees of freedom is studied in detail. Two methods are presented for the precise design of a system that will be as insensitive as may be desired to large parameter variations. One method uses rodt-locus techniques and is suitable for systems with a small number of dominant poles and zeros. The second method is based on frequency response and can be used for systems of any complexity. Numerical examples are given.

621-52

6493 GENERALIZED WEIGHTING FUNCTION AND RESTRICTED STABILITY OF A LINEAR PULSE-MODULATED ERROR FEEDBACK SYSTEM. W.A.Janos.
I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 18-24 (Jan., 1960).

An extensive mathematical development is used to produce a generalized weighting function, for a linear feedback system with a pulse-modulated error signal, in the form of a matrix operator acting on an input vector consisting of the first R-1 input derivatives where R is the order of the unmodulated closed-loop system. Since the system operator has the form of a finite dimensional matrix, it becomes possible to make and to realize more stringent conditions on the transient stability in terms of a preassigned bounded output after a preassigned time. Two examples are given to illustrate the procedure.

621-52

6494 THE ANALYSIS OF DEMODULATING COMPENSATING NETWORKS. G.J.Murphy and J.F.Egan.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 71-9 (Dec., 1959).

A method for determining a sampled-data system which is equivalent to a given member of a class of periodically switched electric networks is first presented. A technique for determining the response of the system to a given input function is then discussed in detail. It is shown that it is possible to identify a time-invariant electric network with the same response to a step-function input as the envelope of the response of the switched network exhibits when the input to the switched network is a suddenly applied constant-amplitude sinusoid at the switching frequency. This "equivalent" d.c. network can be utilized to advantage in the design of carrier systems in which periodically switched electric networks are employed as compensators. Examples are then presented to illustrate the application of the theory, and the results obtained by this method are compared with those obtained by a different method, proposed earlier. It is pointed out that the response calculated by the use of the method presented is theoretically exact and that the technique can be extended to encompass a wide class of periodically switched linear systems.

621-52

6495 D-DECOMPOSITION ANALYSIS OF AUTOMATIC CONTROL SYSTEMS. R.W.Lanzkron and T.J.Higgins.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 150-71 (Dec., 1959).

Development of the basic theory of D-decomposition by a general polynomial expression, the characteristic function of a linear lumped parameter automatic control system, is followed by account of: the basic theory of parametric stability; unity-feedback variable-gain analysis, with subsequent generalization to numeric and frequency-dependent feedback; transient response determination; and sampled-data system analysis, as effected by D-decomposition theory. Application of theory in practice is illustrated by numerous illustrative examples.

621-52

6496 SYNTHESIS OF FEEDBACK SYSTEMS WITH SPECIFIED OPEN-LOOP AND CLOSED-LOOP POLES AND ZEROS. W.E.Carpenter.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 185-96 (Dec., 1959).

Describes a graphical method for synthesizing a compensation network where the fixed poles and zeros of the open-loop system are given and the closed-loop poles and zeros are independently specified. The resulting network is general in that it may have both real and complex poles and zeros. The method does not rely on cancellation techniques to determine the compensation network which is often simpler than one which would have resulted from the use of such techniques. In contrast to the Bode and Nyquist methods, wherein phase and gain requirements over a frequency band are used to generate compensation networks, this approach uses requirements at points in the s-plane, such as those imposed by desired transient response, to construct a solution of the problem. The graphical procedure is iterative. In many cases, convergence is rapid, and several techniques are suggested to further increase the speed of solution.

621-52

6497 RAPID DETERMINATION OF APPROXIMATE CLOSED-LOOP POLES OF FEEDBACK CONTROL SYSTEMS. S.K.Basu.
Trans Amer. Inst. Elect. Engrs II, Vol. 79, 96-9 (1960) = Applic. and Industr., No. 48 (May, 1960).

In a control system, the transient response can be determined accurately only when the closed-loop poles of the system are known. The determination of the closed-loop poles involves in general a solution of a high-degree equation, which is difficult when the degree of the equation exceeds two. An extension of an already existing graphical method is suggested. The technique followed requires an asymptotic gain–frequency plot of the given open-loop transfer function. The plot is divided into three regions, viz., the high-gain region, the low-gain region, and the region near the cross-over frequency. The closed-loop real poles are determined for high-gain and low-gain regions from known relationships of closed-loop and open-loop functions. From the knowledge derived therefrom, the complex-conjugate roots (along with real roots, if any) are determined for the crossover frequency region.

621-52

6498 SPECTRAL CHARACTERIZATION OF CONTROL SYSTEM NONLINEARITIES. R.B.McGhee.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 199-211 (Dec., 1959).

Control system feedback elements are subject to statistical variation from their desired characteristics due to manufacturing tolerances. For most feedback elements, this variation takes the form of a random function of the input to the element. Analysis of

the effects of such feedback errors is exceedingly difficult because the control system affected must be described by a random nonlinear differential equation. It is proposed that this difficulty be surmounted by computer simulation. For purposes of simulation, a power spectrum is developed for the ensemble of feedback error functions. This power spectrum is then used to synthesize artificial nonlinearities in the simulation of the control system. By simulating groups of components with different statistical properties, production specifications can be generated on parameters borrowed from noise theory such as power spectral density, noise bandwidth, r.m.s. error, etc. This development is followed by two experimental examples which illustrate the application of the method and display the concept of bandwidth as applied to a feedback nonlinearity. It is shown that, in some situations, linearizing approximations permit analytic determination of the effects of random feedback error. In other problems, the utilization of power spectra permits the normalization of computer results.

621-52

6499 TECHNIQUES FOR THE OPTIMUM SYNTHESIS OF MULTIPOLE CONTROL SYSTEMS WITH RANDOM PROCESSES AS INPUTS. H.C.Hsieh and C.T.Leondes.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 212-31 (Dec., 1959).

Considers the general problem of obtaining the optimum multipole system when the inputs to the system are stationary random processes. The system under investigation is linear and time invariant. The input to each terminal consists of signal and noise. The synthesis procedure is carried out on the basis that a fixed plant must be compensated in order to perform certain desired tasks. The design criterion employed in the minimum mean square error between actual outputs and ideal outputs of the system. A set of integral equations is obtained, which can be converted into algebraic equations through transformation. By solving these equations and using the method of undetermined coefficients, the transfer functions of the compensation can be uniquely determined.

621-52

6500 DYNAMIC PROGRAMMING AND ADAPTIVE PROCESSES: MATHEMATICAL FOUNDATION. R.Bellman and R.Kalaba.
I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 5-10 (Jan., 1960).

Discusses fundamental aspects of control systems, the principles of feedback, and the nature of adaptive processes. A foundation for the mathematical treatment of broad classes of the adaptive processes through the use of the concepts of dynamic programming is given.

621-52

6501 OPTIMIZATION BASED ON A SQUARE-ERROR CRITERION WITH AN ARBITRARY WEIGHTING FUNCTION. G.J.Murphy and N.T.Bold.
I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 24-30 (Jan., 1960).

Several important criteria for the performance of communication systems and control systems are reviewed, and a new criterion (the mean-weighted-square-error criterion) is then introduced. This is shown to be a special form of a very general criterion proposed earlier, but to have special significance in that it is a generalization of the familiar mean-square-error criterion. The minimization of the mean weighted-square error is treated in detail, and a solution for the optimum physically realizable frequency function of the system is given.

621-52

6502 ROOT LOCUS PROPERTIES AND SENSITIVITY RELATIONS IN CONTROL SYSTEMS. H.Ur.
I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 57-65 (Jan., 1960).

Properties of the well-known root locus including pole sensitivity, angle of slope, and curvature are investigated, and a relationship between the sensitivity function and pole sensitivity is established. It is shown that the sensitivity determines variations in the transfer function due to large as well as small variations in the loop gain. Additional properties of the locus are also developed.

621-52

6503 TIME LAG SYSTEMS — A BIBLIOGRAPHY. N.H.Choksy.
I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 66-70 (Jan., 1960).

This bibliography is a large supplement to the one given in the May, 1959, issue (see Abstr. 6203 of 1959) and it includes a thorough discussion of the mathematical characterization of time lags.

621-52

6504 AUTOMATIC CONTROL OF THREE-DIMENSIONAL VECTOR QUANTITIES. II. A.S.Lange.
I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 38-57 (Jan., 1960).

For Pt I, see Abstr. 6209 of 1959. This part introduces the angular velocity vector for the purpose of analysing and designing geometric stabilization systems.

621-52 : 621.372.6

APPLICATION OF THE THEORY OF ORTHOGONAL POLYNOMIALS IN TWO VARIBLES TO A MULTI-GAIN EQUIVALENT LINEARIZATION PROBLEM. See Abstr. 6174

621-52

6505 APPLICATION OF POLE-ZERO CONCEPTS TO DESIGN OF SAMPLED-DATA SYSTEMS. D.P.Lindorff.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 173-84 (Dec., 1959).

Relates the pole–zero configuration of an error-sampled control system to the transient and steady-state response in a form amenable to straightforward synthesis procedures. The approximate transient response, as defined by percent overshoot and rise time, is specified for a generalized quadratic model in terms of readily discernable parameters. The steady-state error coefficients are developed in terms of the closed-loop poles and zeros. Several examples are used to illustrate the procedure and indicate certain practical conclusions.

621-52

6506 IMPROVING THE APPROXIMATION TO A PRESCRIBED TIME PROGRAM. J.D.Brulé.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 355-61 (Dec., 1959).

Considers the problem of obtaining the Laplace transform of a prescribed impulse response, under the constraint that this transform must be a realizable rational function. In general, the solution of this problem requires that approximations be made, either in the time domain or in the frequency domain. A procedure is developed which provides a systematic method for improving the approximation by making small changes in the poles and residues of the transfer function. The effects of such changes on the impulse response are evaluated by means of a Taylor series expansion of the impulse response. It is shown that only the first two terms of this expansion provide a reasonably accurate estimate of these effects. A set of normalized curves are prepared which allow the designer to determine how a given pole or residue should be changed in order to improve the approximation in the time domain. The procedure is demonstrated by applying it to a numerical example.

621-52

6507 AN EXTENSION OF WIENER FILTER THEORY TO PARTLY SAMPLED SYSTEMS. H.M.Robbins.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 4, 362-70 (Dec., 1959).

Treats the problem of optimizing the simplest possible mixed system consisting of an input filter with transfer function K(s), a sampler with sampling interval T, and an output filter with transfer function L(s). Given the power spectra of the input signal and the noise, the object is to find a realizable K and L which in combination minimize the mean square difference between the output h and a "desired output" h_d. h_d is defined by a "desired transfer function" $G_d(s)$, not necessarily realizable, which would produce h_d from the input signal if the noise were absent. KL will in general contain factors periodic in s with period $2\pi j/T$, and such factors may be moved to either side of the sampler without changing the final output, thus introducing a considerable arbitrariness in K and L. However, since these periodic factors represent linear operations on discrete data (such as might be performed inside a digital computer), it is appropriate to separate them out. There are then three functions to be determined; the nonperiodic part of K, the nonperiodic part of L, and the remaining (periodic) factor of KL. Methods for determining these three functions are given. The interesting theoretical point is that the determination is not always unique. In general, there will be a finite number of distinct but equivalent solutions.

621-52

6508 DEMODULATOR LEAD NETWORKS. E.V.Bohn.
I.R.E. Trans Circuit Theory, Vol. CT-7, No. 1, 56-61 (March, 1960).

One of the possible types of compensating networks for carrier-frequency servo systems is the demodulator lead network. By means of synchronous switching a nonlinear operation is performed on the envelope of the input. For the case of very high carrier-to-signal-frequency ratio, an equivalent linear circuit is derived which is that

of a typical d.c. lead network. The response to a step input in conjunction with quasi-stationary Fourier analysis and description of function methods is used to derive the circuit elements. The equivalent circuit is verified experimentally and its range of validity discussed.

621-52

6509 ON THE STABILITY PROBLEMS OF NON-LINEAR CONTROL SYSTEM WITH A STATIONARY RANDOM NOISE. Y.Sawaragi and N.Sugai.
Tech. Rep. Engng Res. Inst. Kyoto Univ., Vol. 9, No. 8 [Rep. No. 60], 140 pp. (May, 1959).

Describes stability problems of a control system containing a saturated non-linear element considering a stationary random noise, the probability distribution function of the magnitude of which is one of Gaussian type. The analysis of such problems is reduced to investigation of the characteristic equation containing an equivalent gain which depends on the amplitude of the sinusoidal portion and variance of the random portion of the input to the nonlinear element in the closed-loop. The calculation can be carried out graphically in the same manner as the method proposed previously [Mem. Fac. Engng Kyoto Univ., Vol. 21, No. 2 1959)]. The stability of the sustained oscillation is obtained by a graphical method. In order to explain the graphical method in detail, a simple control system containing a saturation with a random disturbance is considered. It is found that the amplitude of the sustained oscillation which is observed in this system either decreases or disappears due to the existence of the random noise.

621-52

6510 ON THE "SIGNAL STABILIZATION OF A NON-LINEAR CONTROL SYSTEM" BY IMPRESSING A SINUSOIDAL SIGNAL. Y.Sawaragi and N.Sugai.
Tech. Rep. Engng Res. Inst. Kyoto Univ., Vol. 9, No. 9 [Rep. No. 61], 157 pp. (July, 1959).

The two different equivalent gains of a saturated nonlinear element to an input composed of two sinusoidal signals are obtained by means of the r.m.s. error criterion. Using these equivalent gains, a nonlinear control system can be treated as an equivalent linear one and the stability problems of the nonlinear system can be discussed by the use of the graphical method proposed by authors (see preceding abstract). The problems of signal stabilization proposed by Oldenburger [Automatic Control, Vol. 4, No. 32 (1957)] are discussed.

621-52

6511 MULTI-LOOP AUTOMATIC TEMPERATURE CONTROL SYSTEM DESIGN FOR FLUID DYNAMICS FACILITY HAVING SEVERAL LONG TRANSPORT DELAYS.
G.J.Fiedler and J.J.Landy.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 81-96 (Dec., 1959).

Describes the systems analysis and design of an automatic temperature control system in large fluid dynamics testing complex consuming 470 MW of drive power. The plant can be described mathematically as a 110th order system having 130 feedback loops. Facility component characteristics are mostly nonlinear, with prominent distributed parameters and ten long, variable fluid transport delay times. Important simplifications introduced to make the analysis and design work tractable include: (a) application of the mathematical analogy between the theory of electric transmission lines and gas flow to validate the separation of temperature and pressure variations; (b) selection of control frequency to permit lumped-parameter representation; (c) design and construction of special computer devices and circuitry to simulate transport delays from 0.2 to 141 sec in length. These valid simplifications reduce the plant to a 14th order system having about 50 feedback loops. The simplified system is simulated on an analogue computer for economical synthesis and design of the controllers.

621-52

6512 PENDULOUS VELOCITY METER CONTROL SYNTHESIS. S.G.Shutt and S.A.White.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 60-70 (Dec., 1959).

This paper is primarily concerned with error sources which are affected by the design of a v.m. servo control amplifier. The environmental conditions, the pendulous nature of the v.m., and the accuracy specifications are analysed to provide requirements for synthesis of a v.m. servo control amplifier to achieve the desired system operation.

621-52

6513 REACTION WHEEL ATTITUDE CONTROL FOR SPACE VEHICLES. R.W.Froelich and H.Patapoff.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 139-49 (Dec., 1959).

An attitude control system consisting of motor-driven inertial wheels in conjunction with an over-riding mass ejection system is proposed for use in space vehicles. Control by mass ejection is used to compensate for initial disturbances during separation from the booster, and for removal of unwanted momentum stored in the wheels. The use of reaction wheels permits fine, damped attitude control. A laboratory model of a single-axis control system was constructed. The choice of a suitable platform configuration, selection of a prime mover for the inertial wheel, and the philosophy in the design of the electronics and pneumatics are discussed. Emphasis was placed upon minimization of weight and power consumption. System evaluation includes a discussion of efficiencies, reliability, and torque–speed–power relationships. Sources of disturbances, methods of sensing, and general equations of motion are presented.

621-52

6514 STEAM-TURBINE BUCKETS — AUTOMATICALLY MILLED. R.H.Wilke and A.Rubio.
Mech. Engng, Vol. 82, No. 1, 44-7 (Jan., 1960).

Discusses the application of a computer-controlled milling machine to the machining of steam-turbine blades. A general purpose computer is provided with a general geometrical blade programme and the information specific to the particular blade and cutter, and produces a magnetic tape carrying information relating to the required path of the centre of the cutting-tool; this is fed into a director which interpolates the information, in two dimensions only, using a second-degree curve, and in turn produces in real time a magnetic tape with continuous path information in the form of reference and phase-modulated control signals for control of the milling machine servos on any two axes. Accuracies of $\pm 2 - 3 \times 10^{-3}$ in. were achieved. A.O Stanesby

621-52 : 621.389

6515 SOME APPLICATIONS OF ELECTRONIC EQUIPMENT TO AGRICULTURE. W.D.Gilmour.
Agric. horticult. engng Abstr., Vol. 11, No. 2, 157-64 (1960).

After a general survey of electronic methods of measurement, control, and radiation processing that might be of use in agriculture, some specific problems are discussed. It is considered that the use of electronic equipment on the farms is bound to increase and that the introduction of the transistor will accelerate this trend.
65 references. W.D.Gilmour

621-526

6516 SOME STUDIES ON THE EFFECTS OF LIMITING IN A POSITION CONTROL SERVO CONTAINING BACKLASH.
A.K.Mahalanabis.
Indian J. Phys., Vol. 33, No. 4, 183-96 (April, 1959).

The effects of limiting on the stability of a second-order position-control servomechanism containing backlash in the output coupling were studied. Two cases were considered; the signal being limited is, in the first case, θ_m, the motor speed, and in the second case $\theta_m + \alpha\dot{\theta}_m$, α being a constant. The describing-function method was applied for theoretical analyses and experimental studies were made using a simulator.

621-526

6517 A ROOT-LOCUS METHOD FOR THE ANALYSIS OF NONLINEAR SERVOMECHANISMS. M.J.Abzug.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 38-44 (Dec., 1959).

A root-locus method for the analysis of nonlinear servomechanisms is developed, using the complex convolution theorem of the Laplace transformation. The nonlinear servomechanisms that can be treated by this method are systems that contain nonlinear elements whose input–output relationships can be expressed in the form of power series. With some approximation this includes systems containing ideal relays and linear gains with dead zone. Transfer functions are developed for odd-power and odd-root nonlinear elements. These transfer functions are valid only for sinusoidal inputs and are functions of the frequency as well as the Laplace Transform variables. The method is illustrated by a root-locus analysis on a system that includes an ideal relay. Comparison with existing methods using the Kochenburger describing function

and with transient solutions shows that the new method is reasonably accurate. The usual root-locus synthesis techniques may be applied to improve nonlinear system performance.

621-526

6518 SOME LINEAR AND NONLINEAR ASPECTS OF HOT GAS SERVO DESIGN. R.V.Halstenberg.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 97-107 (Dec., 1959).

Gas servos are considered from a feedback analysis standpoint with emphasis on systems such as would be most suitable for missile applications. Linearized equations are presented for the case where the piston is operating off-centre. The basic stability and response problems are investigated and some of the characteristics of acceleration, pressure, and transient pressure feedback are considered. The use of a thin plate orifice for compensation use is considered and a quasi-linear analysis is carried out in order to obtain a better feel for this type of operation. A criterion for the presence and severity of a jump resonance is derived and applied to certain gas servo feedback configurations. Limiting elsewhere in the system is investigated as a means by which the jump resonance caused by saturation of the valve might be avoided.

621-526

6519 PREDICTOR-RELAY SERVOS WITH RANDOM INPUTS. T.R.Benedict.
I.R.E. Trans Automatic Control, Vol. AC-4, No. 3, 232-45 (Dec., 1959).

An evaluation is presented of a proposal by Smith (Feedback Control Systems. New York: McGraw-Hill, 1958) on the control, by Wiener prediction and a non-linear combination of input and feedback signals, of a saturating element driving a primarily inertial load. This evaluation consists of simulation tests on a high-speed analogue computer with actual continuous random Gaussian inputs. Results presented include: (1) variation of the mean squared error with prediction time; (2) optimum system-parameter dependence upon input signal level; (3) for fixed saturating level, mean squared error comparisons between the predictor-relay servo, and the "McDonald" and "optimum relay" servo; (4) effects of different input spectral width and location; and (5) data on a variation of the basic predictor-relay servo, where minimal-error parameters become relatively independent of input signal level. The error signal is then dealt with. The character of the error is discussed by examples from sinusoidal, transient, and random inputs. The error probability density and distribution functions are found analytically, the results being valid for a class of compensated relay servos (see Abstr. 6222 of 1959). The main result is that the large-amplitude error probability density is of a single-exponential form. Analogue computer measurement of the error probability distribution function verifies the theory.

621-526

6520 SERVOMECHANISMS DESIGN CONSIDERATIONS FOR INFRARED TRACKING SYSTEMS. J.E.Jacobs.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1577-81 (Sept., 1959).

A detailed description of the closed-loop system, proceeding from the simple linear design to a consideration of nonlinear operation. C.Hilsum

621-526

6521 STUDY OF THE EFFECT OF SATURATION IN A SECOND-ORDER SERVOMECHANISM. J.L.Hernández.
Scientia (Valparaiso), Vol. 25, No. 4, 216-27 (Dec., 1958). In Spanish.

The saturation curve of the servo amplifier is expressed as $g(x) = ax/(b + x)$. This expression is used in the differential equation to plot the trajectories in the phase plane, for a step function input and for various system parameters. W.G.Stripp

621-526 : 621.376.2

TRANSFER FUNCTION OF THE CHOPPER MODULATOR.
See Abstr. 6255

TELECONTROL . TELEMETERING

621.398

6522 THE CONSTRUCTION OF MISSILE GUIDANCE CODES RESISTANT TO RANDOM INTERFERENCE.
A.R.Eckler.
Bell Syst. tech. J., Vol. 39, No. 4, 973-94 (July, 1960).

Many types of missiles are guided by a finite set of distinct commands radioed from the ground in the form of a time-sequence of r.f. pulses. The command information is contained in the n-1 time spacings between successive pulses in a group of size n, and is encoded and decoded by means of multitapped delay lines combined with "and" gates. The problem of encoding command information (i.e., selecting the time spacings between pulses) so that m false pulses ($m \leq n-2$) cannot combine with the n true pulses in any way to form a false command is discussed. Although it is very easy to state the restrictions that must be imposed on the time spacings between the pulses in the different commands, no general methods exist for finding, among codes satisfying these restrictions, those codes in which the longest, together with a few empirically derived codes approaching these lower bounds, are presented. The relationship between these codes and the well-known error-correcting binary codes of information theory is discussed.

621.398 : 621.376.3

6523 THRESHOLD IMPROVEMENT IN AN F.M. SUB-CARRIER SYSTEM. B.D.Martin.
I.R.E. Trans Space Electronics and Telemetry, Vol. SET-6, No. 1, 25-33 (March, 1960).

Deals with the causes and characteristics of threshold behaviour in pulse-averaging and phase-coherent ("phase-locked loop") f.m. subcarrier discriminators. An analytical discussion of the basic elements of each form of discriminator is first presented, leading to a comparison of the devices for input modulation indices of one and five, in the presence of noise. For the first time in the literature, the effect of additional output filtering following the ideal phase-coherent loop is discussed. The requisite modulation characteristics for an improved threshold in a phase-locked loop discriminator are presented, followed by a brief description of the approaches which may be taken in the design of such a system.

621.398 : 621.376.5

6524 A VERSATILE P.A.M./P.D.M. DECOMMUTATION STATION. J.A.Adams and W.T.Johnston.
I.R.E. Trans Space Electronics and Telemetry, Vol. SET-6, No. 1, 38-40 (March, 1960).

621.398

6525 TRANSPORTABLE GROUND RECEIVING AND RECORDING EQUIPMENT FOR 24-CHANNEL TELEMETRY. F.G.Diver.
J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 457-64 (June, 1960).

The equipment receives telemetered data in the form of an r.f. carrier in the 400-500 Mc/s range, amplitude-modulated by a frequency-modulated subcarrier, using time-division multiplexing. The demodulated data is photographically recorded both in "histogram" form and as individually selected channel groups. The equipment is designed for operation as either a fixed or a self-contained transportable station. A mechanical selector switch using punched cards expedites selective recording of particular data channels.

621.398

6526 A 600 Mc/s PULSE TELEMETRY SYSTEM. G.T.Hardwick.
J. Brit. Instn Radio Engrs, Vol. 20, No. 6, 465-73 (June, 1960).

The ground equipment is described for a telemetry system employing p.p.m. in which the information is conveyed by variations of the delay time between a wide datum pulse and up to twenty narrow pulses. In order to explain the nature of the signals with which the ground equipment has to deal, a brief description is given of the airborne equipment. This is followed by a description of the operational ground equipment and of the ancillary equipment for calibration and testing. Finally, details are given which illustrate some of the problems involved in the development of the ground equipment and methods used to meet certain design requirements.

621.398 : 621.317.39

6527 TRANSMISSION OF TEMPERATURE DATA BY CHANGE IN DEPTH OF MODULATION.

V.P.Bhatnagar and D.P.Bhatnagar.

J. sci. industr. Res., Vol. 19B, No. 5, 152-4 (May, 1960).

A radio-link method of transmitting data on temperature is described. The principle employed is based on the fact that changes in temperature which are to be transmitted bring about corresponding changes in the resistance of a thermistor placed in an a.f. circuit. The a.f. voltage across the resistance is used to modulate the carrier of the transmitter. The changes in the depth of modulation are read at the receiver end of a meter directly calibrated in degrees of temperature. The usefulness of the method is demonstrated for ranges of a few hundred metres and can be satisfactorily extended to long ranges with suitable means for receiver noise suppression and a more powerful transmitter. In contrast to the fixed receiver in line channel systems, the receiver in this method can be located anywhere and can be moved easily from place to place; the method can be used in place of a line channel system where the latter cannot be used for practical reasons.

621.398 : 525

6528 ELECTRICALLY-CONTROLLED DEMAND-THRUST ROCKETS FOR SATELLITE GUIDANCE. D.D.Ordahl.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 517-19 (April, 1960).

To accomplish accurate control of satellite orbit and/or attitude with rocket motors requires extremely precise regulation of thrusts, generally in the range between 0 to 1 or 0 to 10 lb. It must be possible to turn these control forces on and off in a few milliseconds repeatedly or intermittently over periods of from several months to perhaps several years. For use in such applications, rocket units were investigated which employ the combination of storable-liquid propellants and demand-thrust injectors capable of complete remote control. An experimental model of a 0- to 10 lb. thrust engine was successfully demonstrated. Three types of electrically actuated control systems are being investigated. These systems employ direct solenoid control, a magnetic ram hydraulic booster, and a micropump with a hydraulic servomechanism. Guidance signals of 50 μA are used to regulate power to the engine controls.

COMPUTERS . APPLICATIONS

(Refer also to Digital circuits . Switching circuits)

681.142

6529 SOVIET COMPUTER TECHNOLOGY — 1959. Edited by W.H.Ware.

I.R.E. Trans Electronic Comput., Vol. EC-9, No. 1, 72-120 (March, 1960).

Presents a factual account of the visit of the 1959 U.S. technical delegation in computers to the Soviet Union. It includes the itinery, description of specific Soviet computers, descriptions of certain computing centres, a discussion of Soviet computer-oriented education, and a description of current circuit and component development. In appendices are given the instruction repertoire of the URAL-I and the URAL-II machines, and an analysis of some magnetic cores. The paper is extensively illustrated and contains a bibliography of relevant Soviet documents.

681.142

6530 MULTIPLE-RATE SAMPLED DATA SYSTEM. L.A.Gimpelson.

I.R.E. Trans Automatic Control, Vol. AC-5, No. 1, 30-7 (Jan., 1960).

Large classes of digital systems employing computers have several pulse rates for economy or because of the nature of the computation. Techniques for analysing these systems containing both discrete and continuous variables with flow graphs and sub-multiple-rate Z transforms are discussed. Tables and examples are given to illustrate the techniques involved.

681.142

6531 SYNTHESIS OF MINIMAL-STATE MACHINES. S.Ginsburg.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 441-9 (Dec., 1959).

A technique is presented which yields a minimal-state machine satisfying a given set of behavioural specifications. The machine is constructed in the same manner as has commonly been done in the past in synthesizing a "primitive flow table". This contribution consists, not in describing a new method of synthesizing machines, but in showing that a particular instance of an established method yields a minimal-state machine. It is shown that the basic synthesis technique may be slightly modified so as to be applicable to obtaining a minimal-state machine which has the stability conditions desired when working with unclocked circuits.

681.142

6532 ARITHMETIC OPERATIONS FOR DIGITAL COMPUTERS USING A MODIFIED REFLECTED BINARY CODE.

H.M.Lucal.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 449-58 (Dec., 1959).

Presents a method for performing the arithmetic operations of addition, subtraction, multiplication, and division using a modified reflected binary code. The modification for integral numbers is essentially the addition of an even parity check bit to the Gray code representation. This facilitates both the arithmetic operations and the detection of errors — in the arithmetic process as well as in transmission. An adder using this code requires circuitry which is more complex than that of a conventional binary adder by a factor of about two or three. However, the adder can be used also for subtraction with little additional circuitry and without complementation. In applications where reliability requirements justify the extra circuitry needed for arithmetic error detection, the modified reflected binary code may compare favourably with the conventional binary.

681.142 : 621.318.1

6533 NONDESTRUCTIVE READOUT OF METALLIC-TAPE COMPUTER CORES. L.M.Lambert.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 470-4 (Dec., 1959).

Readout is accomplished by the application of a magnetomotive force spatially in quadrature to the direction of remanent flux. A simple method of fabrication is proposed and empirical data for the design of the nondestructive read systems is obtained. The use of nondestructive readout is not limited to digital computer circuits and no attempt has been made to use this method in any particular application; an experimental shift register was built, however, to test the method in a practical application. The nature of the system permits high-speed low-current-level operation in either digital or analogue applications.

681.142

6534 THE DESIGN OF A LARGE ELECTROSTATIC MEMORY.

M.Graham, G.L.Miller, H.R.Pate and R.Spinrad.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 4, 479-85 (Dec., 1959).

A large, high-speed random-access memory for the Brookhaven "Merlin" digital computer is described. This system employs barrier grid electrostatic storage tubes in a novel configuration yielding improved relaibility. Basic design considerations are presented together with a description of circuitry and performance.

681.142 : 621.389 : 621.391

HUMAN MEMORY AS AN INFORMATION STORE. See Abstr. 6328

681.142 : 621.395.625.3

6535 HIGH DENSITY DIGITAL MAGNETIC RECORDING TECHNIQUES. A.S.Hoagland and G.C.Bacon.

I.R.E. Trans Electronic Comput., Vol. EC-9, No. 1, 2-11 (March, 1960).

The merit of any high density detection method is ultimately dependent on the "resolution" characteristic of the magnetic components. Justification of readback waveform synthesis through "single pulse" superposition is given. A comprehensive, yet general, readback simulation programme is described which will automatically, for any characteristic pulse, simulate all possible readback signal patterns and test them for specified reading logic as a function of bit density. Amplitude, phase, peak, etc., sensing are compared and the influence of parameter variation on performance indicated. Good correlation with experiment was realized and has greatly reduced time at the bench. The significance of pulse waveform is clearly revealed and this study has provided a guide to head design (ring and probe), permitting the optimization of a total recording system for high-density storage.

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1960). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free. The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Brit. Pwr Engng	British Power Engineering George Newnes, Tower House, Southampton Street, London, W.C.2.
Bull. Amer. Phys. Soc.	Bulletin of the American Physical Society Columbia University, New York 27, N.Y.
Rev. Elect. Commun. Lab. (Tokyo)	Review of the Electrical Communication Laboratory (Formerly: Reports of the Electrical Communication Laboratory) The Electrical Communication Laboratory, Nippon Telegraph and Telephone Public Corporation, 1551, Kitizyôzi, Musasino-si, Tokyo.

CHANGE OF TITLE

Rep. Elect. Commun. Lab. (Tokyo)	Reports of the Electrical Communication Laboratory Title changed to: Review of the Electrical Communication Laboratory [Rev. Elect. Commun. Lab. (Tokyo)] with issue dated Jan.-Feb., 1960.

ERRATA

Abstr. 4918 (1960) line 8: for "consumption is 24 hrs" read "consumption in 24 hrs"
line 10: for "5 kW/m^2" read "5 kWh/m^2".
Abstr. 5909 (1960) line 1: for "D [illegible]K" read "DANSK".
July (1960) p. 417: for "4356" read "4256".
Author Index (July, 1960): for "Garneta,O" read "Garreta,O".

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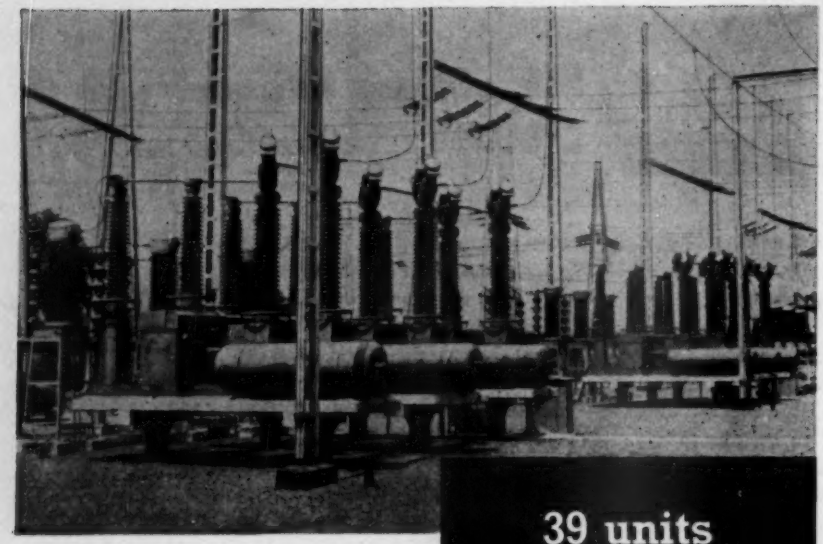

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